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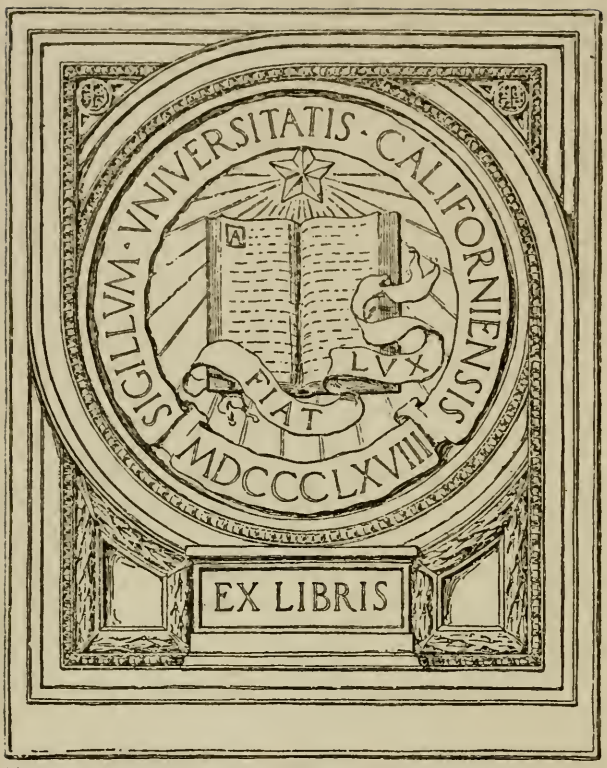

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THE MIND AT WORK

THE MIND AT WORK

A HANDBOOK OF APPLIED PSYCHOLOGY

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PREFATORY NOTE

I CANNOT send this book to press without a brief word of thanks to the eminent scientists who have directly and indirectly assisted in its production.

I am specially indebted for help to Dr. Hyslop, late Superintendent of Bethlem Hospital, Professor Max Meyer, and to my contributors, Dr. Buttar and Mr. E. J. Foley. The latter, who is responsible for nine chapters, asks me to print the following note:

"It would have been perhaps impossible, and certainly tedious, to give, in the part of this book for which I am responsible, the authorities for the statements made. In a few instances the source is stated; in most, not; and it is not to be assumed that where no obligation is acknowledged, none exists. The words are usually mine, but to students of the subject it will be clear how much of this groundwork of Psychology is taken from William James, Dr. Ward, Professor Stout, and

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other well-known workers in the field. The aim has been to give a condensed but lucid and sufficient statement of the generally accepted elements of the science. At the present stage of psychological enquiry this could hardly be original, and save to some extent for the arrangement and generally for the expression, originality is not claimed."

G. R.

LONDON,
January, 1914

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THE MIND AT WORK

INTRODUCTION

Psychology has been defined as *the description and explanation of states of consciousness as such.* I prefer to state simply that it is the study of *personality* in all its aspects ; and its subject-matter is grouped under the heads of thoughts, feelings, and volition, or will. To speak quite popularly, one might say that it is concerned with the working of the human mind.

The study of the mind cannot properly be separated from the study of the body, for the two are most intimately related. We all know that when tired and hungry the brain refuses to work. We cannot think clearly. A glass of wine and a biscuit and a short rest restores to us our mental faculties. Or to put the case the other way, good news stimulates appetite, while shock or anxiety gives a distaste for food. These are simple and obvious illustrations; but there are much more remarkable ones that we shall have to discuss later on.

The greater part of our mental life is necessarily made up of impressions of the outside world that reach us by means of our senses. The eyes and ears and other receptive organs are constantly telegraphing messages to the brain along the nerve fibres. It is one of the chief functions of the mind to interpret these messages, and they eventually, in some mysterious fashion, pass into the region of our consciousness. These primary sensations of a physical origin supply the science of psychology with a convenient starting-point for its investigation, and the study of sensation forms a link between the science of the body and the science of the mind.

Peculiarities of Sensation.—Before discussing the senses, such as sight, hearing, touch, etc., in detail, we have to consider certain general laws that apply to all of them. We shall find that unless forewarned there is great danger of one being seriously misled by the knowledge we get by means of our senses. We shall prove this by experiments in later chapters, but one or two simple illustrations may be given here. We all know that the same object at different distances from the eyes seems to be of a different size, and I have often heard a small child, looking out of the window of a railway carriage, exclaim "Look at that tiny house!" or "Aren't the cows small!" Experience teaches the adult that the actual size

of the house or the cow is the same; it is merely the appearance, the image projected by the eye, that is smaller.

Again, anybody who lives near a railway-line knows that the noise of the train that is at first so distressing *gradually disappears* until it passes quite unnoticed. The noise is there still, but the nerves no longer react to it in the same way. The study of these illusions is an important branch of the science of psychology, for it is material to our knowledge of things to eliminate as far as possible sources of error. A merchant who sends a cargo of grain across the sea knows that he has to make an allowance for "wastage." The sacks of grain "leak" when put on board ship and again on being taken out, and, in addition, a number of sacks are certain to burst open and their contents be spoiled. Supposing, for instance, he shipped a thousand sacks, each containing a hundredweight of corn in New York, he might reasonably expect to deliver perhaps 950 hundredweight of corn in Liverpool. The difference representing the "wastage." Now, a similar allowance has to be made in connection with our "knowledge" of things. Temperament, prejudice, education, have all to be reckoned with in dealing with the human mind. If a tailor, a doctor, and an artist, were to give an account of the people who passed through a big railway-station during the space of an hour, each report

would be different, and yet one might say, broadly speaking, they had each witnessed the same scenes! Professor Miers has directed attention to this tendency on the part of the mind to be led astray:

"I think that teachers and investigators do not sufficiently bear in mind two possible dangers that beset them under modern conditions of work. It is inherent in our senses and our intelligence, first, that those whose attention is too minutely fixed upon one thing will fail to perceive other things which are equally discernible and equally important; and, secondly, that those who look or listen too intently for a thing may actually see or hear that which they desire, even though it be not there."

"Let me illustrate what I mean by one or two homely examples: The conjurer and the spiritualistic performer know well the need of concentrating the attention of their audience upon an unimportant thing if they wish to render them blind and deaf to those actions which would betray the trick. In fact, every illusion depends for its success upon the distraction of the attention from one thing by the simple artifice of concentrating it upon another. The person who is best able to see through the illusion is the trained conjurer, who is in the habit of noticing everything in order that his victims may notice nothing.

One of the most fascinating chapters in the autobiography of the famous conjurer, Robert Houdin, is the account of the manner in which his father trained him to observe with rapidity every possible detail in passing through a room, so that the knowledge thus instantaneously acquired could be used afterwards to confound those ordinary folk who only see what interests or attracts them, and do not observe trivial details. And this training was undergone, not with the object of understanding the illusions of others, but of deceiving them with illusions that depended for their success upon the insignificant details so absorbed. And then Houdin further narrates how he was always educating not only his sight, but his touch and the other senses, in order that they might constantly be on the alert."

"Everyone is familiar with the fact that absent-mindedness is generally the result, not of a wandering mind, but of one concentrated upon some absorbing object, and that what is true of the senses is also true of the intelligence: concentration may induce temporary mental blindness."

"And then there is the other defect which I have mentioned, and may illustrate by two examples of which I read at the time of their occurrence, and which indicate that expectation may deceive the senses, and actually create impressions

of what does not exist. One of these is quoted by Carpenter in his 'Mental Physiology.' When the French air-ship 'La Patrie' was blown from her moorings and drifted derelict across England, her passage across the Bristol Channel was witnessed by a number of persons who, in the early morning light, were able to identify her, and naturally assumed that she was being navigated across the country. They were not only able to read her name, but persuaded themselves that they could discern two aeronauts on board, and could see them sending out carrier pigeons."

"Again, when the tropical annexe of the Crystal Palace was burnt down, a large concourse of people witnessed the conflagration, attracted by the extraordinary spectacle of the streams of molten glass. It was known that a number of animals, parrots, and monkeys, were kept in that annexe, and were burnt to death. One ape had escaped to the roof, where it clung for a long time unable to escape, and was literally roasted to death before the eyes of the agonized spectators, who were not only witnesses of its contortions, but also heard the poor creature's screams. After the conflagration it was found that the object which had excited such interest and compassion was a piece of tarpaulin."

"This defect also belongs not only to the senses, but to the intelligence. It frequently

happens that an acute and eager mind is so obsessed by some idea which distorts the judgment that the victim of it is led to explain everything in the light of the fixed idea, and to ignore other possibilities. In fact, many of the mistakes of investigators are made in this way."

We see here at once one of the great values attaching to the study of psychology. It enables us to discern the weak points in our "mental machinery," and accordingly enables us to avoid the pitfalls which are the natural outcome of those "weak points." In a similar way the process that we call "collecting our thoughts" has important problems for psychology. It is quite analogous to getting our materials round us for any ordinary piece of work. The cobbler and the carpenter put their tools out before commencing a job, and we must collect our thoughts, so as to have them handy.

Although much of our work will consist of the examination of what appear to be purely mechanical processes, we must not be led from that to suppose that the mind is merely a "function of matter." All *knowledge* presupposes a *knower.* It would be idle to discuss sensations or thoughts or feelings if we lose sight of the individual who *has* those sensations or thoughts or feelings.

The Self.—All human experience of whatever

kind must have a beginning, and that beginning must be associated with the first gleam of conscious life. *I know that I am I.* We start there. In recent years scientists and scholars have devoted much time to the study of the phenomena of consciousness with important results. The psycho-physiological side of the subject we have already considered. But there is another, and perhaps more important, branch of the work. We have learned, among other things, that the discretion of purposeful actions associated with a realization of personal identity, so far from representing the entirety of our consciousness, is only its focal-point. Much of our conscious life goes on without thought or effort on our part. We breathe and digest, for instance, without having wittingly given any fiat for these actions to take place. There are also other functions of the body that would appear to be mainly under the control of some agent removed from the theatre of our immediate attention. Once we have mastered the art of walking and talking, or even swimming or dancing, we perform these actions automatically at will. Without at present going more deeply into this fascinating department of psychology and discussing the phenomena of subconsciousness, we may say that it is certain that our mental powers are not limited in their operation by any captious *yea* or *nay* on our part.

We may rule in the dominion of the mind, but we cannot be autocrats. We must govern constitutionally. There is a further point in this connection that we have to bear in mind: It is now generally admitted among scientific men that we possess psychic or mental powers in abeyance. "Just as there are in the world of physical science forces whose existence we are only now beginning to recognize, and whose capabilities are still unknown to us, there are undoubtedly psychic forces in man that are capable of development, but of whose exact nature we at present are ignorant, although we can trace their effects." A simple illustration will make this theory clear. If we imagine a man with a gift for languages who speaks, say, English, French, and German, we shall have no difficulty in believing him capable of learning Italian, given the opportunity of acquiring that language. We could therefore correctly say he had a mental power in abeyance or undeveloped. The same would apply in the case of a person possessed of an ear for music, who had learned to play the violin, but not the piano.

We have arrived, then, at the following main *Branches of Psychology:*

I. *Sensation*, dealing with the messages that travel along the nerves to the brain,

such as sensations of sound, or vision, or pleasurable or painful sensations, followed by—

II. *Reflection* (*or Cerebration*)—The classification and interpretation of these messages by the brain, leading to—

III. *Action.*

It is only intended in this introductory chapter to roughly classify the questions with which the science of psychology has to deal; they will have to be studied in detail later on. We may, however, before concluding, attempt a brief answer to one question that is sure to arise in the student's mind, and that is, "What is the practical value of psychology?"

We say, "The thought is father to the deed," and that is literally true; for we shall see presently that the nature of the action depends on the nature of the idea that dominates consciousness. No one can walk while his mind is wholly absorbed by the idea of rest any more than he can enjoy himself while his mind is obsessed by trouble. We owe our knowledge of this fact to the science of psychology. A practical application of the law may be given: Supposing you entrusted a cup of milk to a small child to carry, and wished to impress upon the youngster the necessity of great care, you might say either one of two things: (*a*) "Don't let go!" or "Don't drop the cup!" or (*b*) "Hold the

cup tight!" Now, psychologically there are two reasons in favour of (*b*). First of all, a positive command is much more powerful than a negation ("Come here!" is more forcible than "Don't go there!"); while, secondly, the words "drop the cup" are what is called a pernicious suggestion, for they bring the idea of dropping the cup into the child's mind, and consequently may lead to disaster, while neither of these two objections can be alleged against (*b*).

Then we pass on to the question of *Habits*. We talk glibly of forming good habits or acquiring bad ones, but give little attention to the causes of which *habit* is the effect. Psychology has a great deal to teach us in connection with habit. When we come to talk about the nerve currents that take messages from the outside world to the brain, we shall come to see that there is a tendency for them to lead to a definite action. For example, a sensation of pain as the prick of a pin leads to a withdrawal of the part hurt. We draw the finger away. Imagine for a moment that the pain of the prick was due to the needle of a hypodermic syringe. We should probably instinctively draw our arm away the first time we had an injection, but knowing the slight pain of the prick of the needle was for our ultimate good, we should naturally steel ourselves against it, and after a moment allow the doctor to press the needle into the flesh with-

out moving. The first tendency, or habit, to draw the arm away has been altered by an exertion of will to a second tendency or habit—that of keeping still in spite of the pain.

"Habit is ten times nature!" the Duke of Wellington is credited with saying. The importance of forming useful habits certainly cannot be over-rated. We shall discuss habit at greater length when we come to consider the *will.*

Lastly, *Education* has advanced by leaps and bounds since psychology came to its assistance. The late Professor William James gives some sound advice in this connection. It is expressed in his inimitable breezy style and we may well find space for it here:

"The great thing, in all education, is to *make our nervous system our ally instead of our enemy.* It is to fund and capitalize our acquisitions, and live at ease upon the interest of the fund. *For this we must make automatic and habitual, as early as possible, as many useful actions as we can,* and guard against the growing into ways that are likely to be disadvantageous to us, as we should guard against the plague. The more of the details of our daily life we can hand over to the effortless custody of automatism, the more our higher powers of mind will be set free for their own proper work. There is no more miserable human being than one in whom nothing is habitual but

indecision, and for whom the lighting of every cigar, the drinking of every cup, the time of rising and going to bed every day, and the beginning of every bit of work, are subjects of express volitional deliberation. Full half the time of such a man goes to the deciding, or regretting, of matters which ought to be so ingrained in him as practically not to exist for his consciousness at all. If there be such daily duties not yet ingrained in any one of my readers, let him begin this very hour to set the matter right."

CHAPTER I

ANATOMY OF THE BRAIN AND NERVOUS SYSTEM

Among the lowest forms of animal life there is an animalcule, living in water, named the Amœba. This organism may be taken as the type of a single animal cell. It consists of a mass of jelly-like protoplasm of irregular outline, containing a comparatively large particle, known as the "nucleus," and numerous smaller granules. There are also spaces full of fluid in the protoplasm called "vacuoles," some of which contain food in the process of digestion. If an amœba is watched carefully, it will be seen that it moves about slowly in search of food; that it is sensitive, and contracts into a more spherical shape when touched; that it feeds on tiny plants and the like, digesting them and excreting waste products; and that it reproduces its kind by a process of division. The amœba is so small in size that one hundred of them side by side may extend only one inch; yet even so it is very much larger than most single cells.

It is from animal cells, originally of similar struc-

ture and of like functions, that the bodies of all animals and of man are built up.

But the myriads of cells of which the body consists do not all retain their amœboid structure and functions. The white corpuscles of the blood remain as single cells, capable of movement, sensitive, and reproducing their kind. Other cells, however, become fixed in an altered form, and devoted to special purposes. Thus some become muscle fibres, especially devoted to the function of movement; others deal with the processes of digestion, preparing and absorbing the food to nourish the rest of the body; others have lining, supporting, or protecting functions, as in the case of the skin or the bones; while yet another set of cells is concerned pre-eminently with sensation, and the various mental and nervous functions connected therewith. The masses of cells, with their projections and products, which become specialized in this way, are termed "tissues." Thus there are muscular tissues, nervous tissues, supporting or connective tissues, and glandular tissues. In vertebrate animals the cells and the processes and products of cells which form the nervous system are partly aggregated into large masses of nervous material—the brain and the spinal cord—and partly scattered throughout the body as end-organs, the two being connected by fine threads known as nerves,

while fibrils from the nerves are distributed to every tissue in the body.

With the development of the knowledge of the human body, the study of psychology would be of little use without some acquaintance with the anatomy and physiology of the nervous system.

The anatomy of the nervous system may be considered under two heads—the macroscopic appearances and the microscopic. The macroscopic anatomy is such as can be observed by the naked eye. If the skull of one of the higher animals be opened, it will be found to contain a soft greyish-white mass—the brain. This mass is divisible into different portions, partly separated by projections from the lining membrane of the inside of the skull. The highest and by far the largest part consists of the two cerebral hemispheres forming the fore-brain, lying side by side, and connected below with the small mid-brain. Behind the latter is the hind-brain, or cerebellum; while the junction with the spinal cord is effected through the medulla oblongata, or after-brain.

The spinal cord is continued from the medulla oblongata through the greater part of the spinal canal, which is a tube formed by the bones of the vertebral column.

Attached to the lower surface of the brain and to the spinal cord are numerous pairs of white, or greyish-white, cords, which leave the skull and

the spinal canal through bony apertures or canals. These cords are the nerves, and after their exit from the apertures between the bones, they divide like the branches of a tree, getting gradually smaller and smaller as they divide, until the terminal threads may be traced to every organ and structure of the body. The endings of these nerves are so fine that they can no longer be examined macroscopically; they can be traced only by means of the microscope. The whole of the body is permeated by these filaments, tiny branches going to such structures as small blood-vessels, or even to single cells.

The surface of the brain is covered with deep furrows, the ridges between the furrows being described as convolutions. By means of these furrows and ridges it has been possible to mark out the surface of the brain geographically, as in a map; and such a mapping out is important, because it has been found that certain areas of the surface of the brain are associated with certain of the functions of the body; and it is necessary to be able to describe exactly the situation of any particular area. The more highly developed animals have the largest number of convolutions in the brain; and man has more convolutions than any other animal.

If the substance of the brain or spinal cord is cut across, it is found that some portions of the

exposed surface are greyish in appearance, while other portions appear white. The grey portions are those which contain numerous cells; the white portions are formed chiefly by nerve fibres, similar to the filaments already described as distributed throughout the whole body. In the brain the grey matter is largely on the surface of the convolutions, the white fibres being situated in the substance of the organ. In the spinal cord, on the other hand, the grey matter is seen in the central part of the cross section, surrounded almost completely by the white. The convolutions of the brain produce a large extension of the area of the grey matter of the brain; for this grey matter exists, not only on the summit of the convolutions, where it is visible in the uncut brain, but also dips down and lines each furrow. Thus, the grey matter of the surface of the cerebral hemisphere might be regarded as an almost complete large sphere, which has been crinkled up into convolutions to enable it to be packed into the contracted space of the cavity of the skull. The inside of this crinkled sphere is filled by white nerve fibres, streaming up to every part of the inner surface of the grey matter, and ultimately connected with the nerve cells distributed throughout the grey surface of the brain. Amongst these white fibres are certain masses of grey matter whose function is at present for the most part unknown.

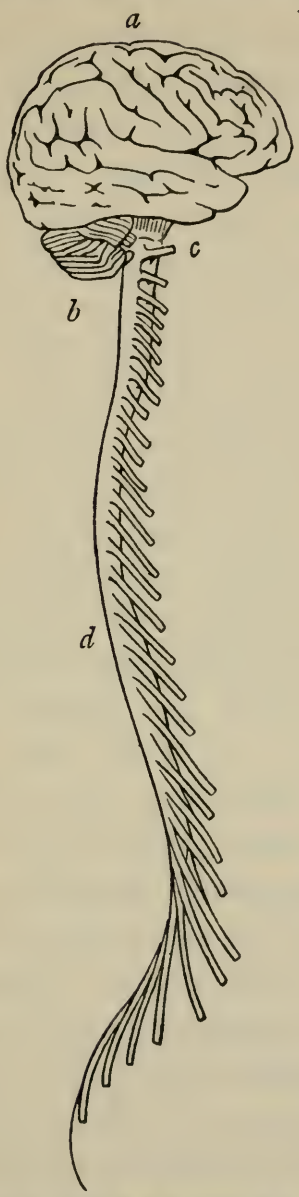


DIAGRAM OF BRAIN AND SPINAL CORD.

a. Cerebral hemisphere. *b*. Cerebellum. *c*. Medulla oblongata. *d*. Spinal cord, with attached nerve trunks, cut an inch or two after leaving the cord, and before they begin to branch.

The nerves connected with the brain and spinal cord may be traced, as has been said already, to almost every portion of the body. Some of them terminate in what are called "special sense organs." Thus, the first nerve of the brain goes to the nose, to be associated with the sense of smell. The second nerve ends at the back of the eye, the special organ of vision. Other nerves may be traced to cells or sense organs in the tongue, constituting the organ of taste, and to the organ of hearing in the ear. Many of the nerves end in the skin, in which there are tiny organs connected with the sensations of touch, of heat and cold, and of pressure. Again, each muscle has distributed to it a special branch of a nerve, to control its movements. These branches are quite large enough to be seen by the naked eye; but when inside the muscle, the nerve splits up into an infinite number of microscopic threads, to be attached to individual fibres of the distinct mass of flesh to which we give the name of "muscle."

So far, the investigation of the nervous system has been possible merely with the aid of a knife and the naked eye. In the further study of the structure of the nervous material of the body, recourse must be had to more complicated instruments such as the microscope, combined with auxiliary methods such as staining with various

dyes of portions of the tissues. By these means it has been made out that the whole of the central nervous system contains cells of various shapes, mostly with many processes; that some of these processes are very long indeed, and form the terminal filaments of the nerves that run to every part of the body, so that each filament is really a portion of a nerve cell, however far from the cell it may extend; that other processes are short and branched, and ramify amongst, and interlace with, one another, without the branches of any one cell becoming directly continuous with the branches of other cells; and that all these cells and their processes in the great mass of the brain and spinal cord are supported and bound together by a delicate structure, formed by cells of quite a different non-nervous nature, known as "neuroglia cells."

The single long process of the nerve cells is known as the "axis cylinder" or "axone"; the short branched processes are called "dendrites"; and the whole structure of cell, axis cylinder and dendrites is called a "neurone." The brain and spinal cord, therefore, consist of masses of neurones, bound together by neuroglia. Further, the cells and the dendrites of the neurones are found principally in the grey matter of the brain and cord; while the white matter consists chiefly of axis-cylinder processes, which have had added

to them a sheath of insulating or protecting material, much as an electric wire is surrounded by an india-rubber coating. Large numbers of these white fibres run longitudinally through the brain and spinal cord. But many of them run crosswise and interlace. Thus, in the brain, a band of white fibres runs across from one cerebral hemisphere to the other; while other fibres can be traced beneath the furrows, connecting neighbouring convolutions.

It remains briefly to describe one other portion of the nervous system. Deep in the body, in front of the spine or vertebral column, and so outside the spinal canal which contains the cord, there exists a chain of nervous masses called "ganglia," connected by thin soft filaments with the nerves of the central nervous system, with one another, with the internal organs of the body, and with the bloodvessels. This chain of ganglia and filaments is known as the "sympathetic system." The ganglia are composed of nerve cells, similar to those of the brain and spinal cord; the filaments are nerve fibres or axis-cylinder processes; but inasmuch as the protecting sheath is absent from the fibres, all the structures of the sympathetic system are greyish in appearance, and not white like the white matter of the central nervous system, or the nerves that arise therefrom.

Physiology is the science which deals with the

functions of living things, whether plant or animal, and endeavours to explain how the structures described in anatomy do their work. The main function of every individual is the reproduction of its species, and to this all other functions are largely subservient. Thus the body must be preserved by taking food and preparing it for digestion. The prepared food is absorbed into the tissues or structures of the body to replace material expended in the activities of life: waste matters must be got rid of or eliminated. Life must be preserved also by protecting oneself against danger or injury. To achieve these ends two functions are of paramount importance—namely, sensation and motion; and it is with these two that the study of the physiology of the nervous system must begin.

It has been pointed out already that the single-celled organism, the amœba, possesses the powers of sensation and motion in a rudimentary degree. It is able to move about slowly in pursuit of food, and it appears to be attracted by some substances and repelled by others. In moving, it projects a portion of its body in a certain direction, and the rest of its jelly-like substance flows after the projected portion. If irritated, the amœba draws in the projections and tends to become spherical, thus showing the power of contraction possessed by its tissue. In fact, it displays the elements of

the sensitiveness of nervous tissue and of the contractility of muscle. These activities of the cell appear to be the result of complicated chemical processes taking place in its substance, a continual building up and breaking down of complex molecules.

The human body may be regarded as built up of masses of cells, similar to the amœba; but whereas the amœba combines the functions of reproduction, nutrition, sensation, and motion in a single cell, there is in the human body what is called "differentiation of cells and their functions," masses of cells being combined to form organs devoted to one particular function. The cells of certain organs such as the salivary glands, the liver, and the pancreas or sweetbread, produce fluids that deal with the digestion of the food; the cell-lined walls of the stomach and intestines absorb the products of digestion; masses of muscle cells are concerned simply with motion; while the cells of the nervous system specialize in the reception, conduction, and elaboration of the stimuli that lead to sensation.

The sensations received by the body are of different kinds, and put the individual in touch with different aspects of his environment. A sensation, being an affair of consciousness, belongs to the brain; the external phenomenon giving rise to the sensation is known as a "stimulus." Such

stimuli are light, heat, cold, sound, smell, taste, touch, pressure, and painful stimuli such as the prick of a pin or a cut with a knife. Most of these stimuli are received by special cells, some of which are grouped together in organs of some magnitude, such as the eye for light and the ear for sound. Other sense organs may consist of very few or of single cells, such as the end-bulbs of nerves in the skin which have to do with the sensations of touch, pressure, heat, and cold. All these sense organs are connected by means of nerves with the central nervous system, the nerves of sensation being merely like telegraph wires transmitting a message from an outlying office—the sense organ —to the central office in the brain or spinal cord. The nerve fibres themselves have nothing to do with modifying the stimulus ; they simply conduct impulses or impressions from every part of the body, including all the internal structures and organs.

In addition to these sensory or "afferent" nerves which convey the effects of stimuli from the outer world or from the tissues to the central nervous system, there are other nerves which carry impulses away from the central nervous system to various parts of the body. These are known as "efferent," or motor nerves. Efferent nerves convey orders to the muscles, which result in the occurrence of contraction ; through them also the

functions and nutrition of various organs and tissues are controlled. Impulses conveyed through some nerves affect the beating of the heart; others keep control over the bloodvessels. Others, again, are concerned with the secretion of fluids for purposes of digestion, such as the saliva from the salivary glands, the bile from the liver, and so on.

Thus we have an elaborate system whereby information of alteration in the environment or needs of the body is conveyed to the controlling centre, whence, after elaboration of the sensation caused by the stimuli, instructions are conveyed regulating the motions and actions of the body in accordance with its changing needs. The body may be regarded as a huge community of cells. Individual cells of certain kinds are arranged in masses in different localities in the community, each mass having certain duties appointed to it. The community is so bound together that no mass can move separately, nor can one mass with certain duties take up the work of another mass with different functions; if any particular mass ceases to carry out its appointed work, the whole community is liable to suffer. Hence a very complete system of telephonic or telegraphic communication is necessary, and most of the cells in the community are connected by a telegraph wire with the guiding and controlling office in the central nervous system. For the purpose of

keeping the community in touch with its surroundings, myriads of messages are continually pouring in to the central office from every quarter. One portion of the community demands more nourishment, another may require the removal of an irritant. Through the sight warning may be given of the approach of danger. The eyes which send this message know nothing of the meaning of it; they merely collect a picture of the wild animal that may be in the path. But this picture transmitted by the optic nerve to the brain leads to the sensation of sight; the sensation is recognized and associated with past experiences of danger; the emotion of fear is aroused; the will is stimulated to action; the whole of the defensive mechanism of the body is set in motion, and the lion is shot or the defenceless hunter climbs a tree.

CHAPTER II

PHYSIOLOGY OF THE BRAIN AND NERVOUS SYSTEM

Our knowledge of the physiology of the nervous system has been built up by a long and laborious process of observation and experiment. If the point of a pin is placed upon the skin, the first sensation is one of touch, or contact. If greater force is used, the sensation of contact becomes one of pressure. If the pressure is continued until the point of the pin pierces the superficial layers of the skin, the stimulus conveyed by the injured nerve fibrils produces a sensation of pain. Again, the rays of the sun or the radiation from a fire produce a sensation of heat, while a mass of ice feels cold. But suppose that, as the result of disease or injury, the nerve connecting a part of the body—say, one arm—with the spinal cord is divided, it is found then that stimuli applied to this part of the body no longer lead to sensations. A pin may be pushed deeply into the flesh: it arouses no feeling. The skin may be burnt by an overheated hot-water bottle, but the patient makes no attempt to move the limb, and

will assert that he feels nothing. These simple observations and experiments show that for stimuli applied to any part of the body to produce sensations in consciousness it is necessary that the nerves between that part of the body and the central nervous system shall be intact.

But stimuli applied to various parts of the body generally produce something more than sensation in consciousness, and under certain conditions they may produce certain effects without any sensation. If one leg is crossed over the other, and a smart tap is given to the tendon below the knee-cap, the leg will give a sudden jerk or kick. This phenomenon is known as the "knee jerk," and is an instance of what is called "reflex action." Striking the stretched tendon sends an impulse up to the spinal cord, and this impulse is immediately reflected down the efferent nerves that go to the large muscles in front of the thigh, and causes a sudden contraction. In the healthy person the production of the knee jerk is accompanied by certain sensations—a feeling of the tap on the tendon, and of the contraction of the muscle; but if the spinal cord is injured or diseased above the spot at which the nerves from the tendon enter it and those to the muscle leave it, a tap on the tendon will produce a greatly increased knee jerk, while the patient will feel nothing. This observation shows two things:

first, that for the reflex action to produce sensation certain nerves which run in the spinal cord up towards the brain must be intact; and, secondly, that in normal conditions of health certain impulses must be passing down the spinal cord from the higher nervous centres which control, or, as it is called "inhibit," excessive reflex action. If either the nerve from the tendon to the spinal cord or the nerve from the spinal cord to the muscle is divided, or if the injury to the spinal cord is at the spot where the interchange of afferent to efferent impulse occurs, no reflex action can be produced.

There are many other instances of reflex action in the body. Thus, tickling the sole of the foot will lead to the leg being suddenly drawn away; a feigned blow at the eyes or a sudden flash of light will lead to involuntary closing of the eyelid; a loud, unexpected noise will cause a start. Many of these reflex actions are protective in character: for example, the eyelid closes to protect the eye from the injurious effect of excessive light.

The mechanism of all these reflex actions appears to be that a stimulus applied to nerve endings in the eye, the ear, the tendon, or the skin, is conveyed through the axis-cylinder processes of afferent nerves to certain cells in or near the central nervous system. Through the

dendrites of these cells the impulse is communicated to the dendrites of other cells, from which it is carried by efferent axis-cylinder processes and their filaments to the muscular fibres. The muscles contract and produce the movement, which no effort of will can prevent for any length of time; and the whole process can be carried out under certain conditions without the person experimented on being conscious of what is happening.

As a rule, however, consciousness is present; and the reason of this is that the effect of the stimulus when it reaches the central nervous system not only flows into the dendrites of the motor cells, which send impulses to the muscles, but spreads also to the dendrites of other cells, whose axis-cylinder processes run up the spinal cord to the higher parts of the brain, where consciousness resides. At the same time, the action of the motor cells is modified and restrained through the dendrites of other cells controlled by the brain, and inhibiting excessive action.

The function of inhibition is a highly important one, and applies throughout the whole of the nervous system. If it did not exist, every response to a stimulus would be very violent, and life would be unendurable. Inhibition applied to the higher portions of the brain is necessary for civilization. For instance, the sight of something desirable will lead to a desire to possess it. The

desirable thing may belong to another person; the desire is inhibited by other motives, and the impulse to steal is resisted.

On approaching the higher parts of the central nervous system, it is found that in the medulla oblongata and the lower part of the brain there exist certain spots which are associated with very important functions of the body. Life can only be preserved by means of the circulation of the blood, by respiration, and by the movements and secretions of various organs connected with digestion. These functions have to do with supplying nourishment to every tissue and organ of the body, and with removing waste products. The secretions of the salivary glands, the liver, and the pancreas or sweetbread, provide certain ferments which help to prepare the food for absorption. The muscles of the mouth, tongue, gullet, stomach, and intestines by their contractions pass the food along the alimentary canal. The lining membrane of the stomach and small intestine absorbs the prepared food into the bloodvessels. The heart pumps the blood containing the absorbed food all over the body, in order to supply every cell and structure with nourishment for its support and work. The blood during its circulation carries away the waste products which result from the active work of the organs and tissues. By means of respiration through the lungs, oxygen

is introduced from the air into the blood to be conveyed to the tissues that are engaged in their work, while one of the waste products of the body, carbonic acid gas, is got rid of in expiration.

These functions are for the most part automatic; they go on continuously without our being conscious of them; and the action of the organs concerned is to a great extent rhythmic. Thus the heart beats regularly about seventy-two times a minute, each beat being a muscular contraction of the walls of its cavities, resulting in driving the blood onward through the bloodvessels. Under ordinary conditions in health we are not conscious of these contractions; the nervous system exercises its control silently and without influence on consciousness. But under certain conditions the rhythm may be altered, and the disturbance produced may lead to unusual sensations. In natural and healthy conditions we are conscious of nothing except the satisfaction of a general feeling of well-being. Everything is working smoothly, and our mind is occupied with other matters. But excitement and other mental emotions make the heart beat faster; while certain influences passing along a nerve derived from a centre in the brain will slow the beats. The bloodvessels also are under nervous control, as is shown by the result of the emotion of shame in leading to blushing. The redness of a blush is due to dilata-

tion of the vessels of the skin, and the consequent increase of blood in them.

Respiration is a function of which we are rather more conscious than of the heart-beat, and one over which we have more voluntary control. Normally it is rhythmic, and occurs about seventeen times a minute. But to a certain extent we are able to increase or diminish the frequency of its occurrence. The function of respiration is under the control of a certain part of the medulla oblongata. This centre is concerned in receiving impulses from various quarters, modifying them, and transmitting them to the muscles which expand the cavity of the chest. Thus in violent exercises the muscles of the body are engaged in active work, and are throwing off an increased amount of waste products. Some of the blood bearing these waste products traverses the medulla oblongata, and stimulates what is called the "respiratory centre." Thereupon the movements of the chest are increased in frequency and depth as a result of impulses from the respiratory centre, larger draughts of oxygen are inhaled to assist the muscles in their work, and the increase in the waste product—carbonic acid gas—is got rid of.

Reflex actions such as sneezing and coughing are produced by irritating stimuli from the mucous membranes of the nose and respiratory passages

affecting the respiratory centre, and overflowing in a violent form to the muscles concerned in movement of the throat, neck, and chest.

The movements and activities of the various organs connected with the swallowing, digestion, and absorption of food, while they are all controlled and regulated by the action of the nervous system, display many phases of this nervous action. Thus mastication is a voluntary and conscious movement; swallowing is largely voluntary, but sensations do not arise as a rule from the gullet under normal conditions. The movements and work of the stomach and small intestine are involuntary and unattended by consciousness in a healthy state. But in disorders or diseases of the digestive organs the stimuli which must be continually pouring in to the central nervous system from every part of the tract in order that the various activities of its different portions may be co-ordinated and controlled in action, may lead to painful sensations.

The co-ordination and control of the activities of the digestive organs are carried out largely by reflex action. The sight or smell or taste of food are sensations due to stimuli carried from end-organs to the brain. The results of these sensations are reflected to the glandular and muscular tissues of the digestive tract. Thus the sight or smell of pleasant food may cause a flow of fluid

from the salivary glands. This saliva is useful for the swallowing and digestion of food; and the sight of something we think pleasant or suitable for our needs has caused the "mouth to water" as a preliminary to its absorption. The smell of something unpleasant may not only produce the emotion of disgust, but also lead to muscular action of the organs connected with swallowing and digestion, and thus cause vomiting. By experiment it has been found that the sensations and emotions connected with food and eating lead to reflex results throughout the organs of digestion. Thus the glands of the stomach and glandular organs, such as the liver and the pancreas, at once prepare for the reception of material for digestion, even before the food has been masticated.

The intimate connection between every portion of the body and the central nervous system by means of the network of nerves is shown by the effects produced by the emotions on the organs of circulation, respiration, or digestion. Examples of such influences are to be found in the palpitation of the heart caused by fear, in the blushing (due to dilatation of the bloodvessels of the skin) caused by shame, or the pallor (due to contraction of bloodvessels) in terror, in the rapid breathing of anger, in the indigestion produced by sorrow or depression, in the diarrhœa caused by anxiety

for the result, say, of an examination. Such results are due to the impulses conveyed to certain regions of the brain overflowing from the dendrites of the receiving cells into neighbouring areas of the nervous system wherein are situated cells whose axis-cylinder processes are connected with lower nerve centres in the brain or spinal cord—centres which have to do with the control of the particular organs affected. Many of these results of emotional disturbance probably are, or have been, purposive or protective in nature, though the connection of the disturbance and the result may be by no means plain.

In a short chapter dealing with the elementary physiology of the nervous system it is impossible to describe the results of the experiments that have been made in localizing various functions of the brain, or to discuss in detail what knowledge we possess. From what has been said already it will have been gathered that impulses are constantly being carried from myriads of sense organs throughout every structure of the body to the central nervous system. These impulses are reflected through efferent or motor nerves, and lead to movement. The whole nervous system is built up of pathways for these impulses, and the pathways are called "sensori-motor arcs." The impulses from the myriads of sense organs ripple continuously through the grey cortex of the brain

producing sensations, only a few of which rise into consciousness. For a sensation only succeeds in reaching consciousness when it is sufficiently strong to attract "attention." Attention cannot be directed to two things at the same moment, but is fixed temporarily for a longer or shorter period on a succession of sensations. When the period during which attention is directed to a sensation is long and frequently repeated, an impression is made which can be recalled, and in this way "memory" is formed. The rest of the sensations have attention so slightly directed to them that they are as little remembered as if they had never been perceived.

One of the most difficult functions of the mind to explain from the physiological side is what is known as the "will." We perform what we call "voluntary movements," when we decide to do any particular thing. But if our actions are analyzed, we find that they all take their origin from impulses arising from the sensory side. If a cold-blooded animal, such as a frog, be deprived of its brain, it will cease to perform any voluntary movements, although continuing to live for a long period. In such a frog, if a drop of acid be placed on the skin of the side, one of the hind-legs will at once make an effort to wipe the acid away. This complicated action of the muscles of the leg is purely reflex, and due to an impulse carried by

sensory nerves to the spinal cord and thence by motor nerves to the muscles of the leg. But when the brain is intact, the irritant action of the acid becomes an impulse carried up the length of the spinal cord to become a sensation and rise into consciousness in the brain. The movements then adopted may become more complicated and more successful in removing the acid, and we call them "voluntary movements." But probably they are still really of a sensori-motor nature; the continued presence of the irritant leads to stronger and stronger impulses, to a greater fixation of the attention, to the overflow of the impulses over a wider and wider area of the brain substance. It is supposed that what are called "kinæsthetic" images of the sensations, which will result from the so-called "voluntary" movement, are called up in the mind. The agitated part of the brain in which these kinæsthetic images are produced is connected by association nerve fibres with neurones, the processes of which descend to spots in the spinal cord from which motor axis-cylinder processes run to the muscles. At all events, voluntary movements appear to consist in opening channels through which sensory or afferent impulses from nerve endings in and around the muscles themselves to the spinal cord may flow into efferent or motor nerves.

When a particular action is repeated very fre-

quently, the sensori-motor path through the central nervous system becomes so well worn that the action becomes what is known as "automatic." An action that may have been at first so unusual or difficult as to have fixed the attention for prolonged periods, may in the end become so automatic as hardly to rise into consciousness at all. And the effect on the mind of such a frequently repeated action is that it leaves no memory behind it. It becomes what we describe as a "habit." An enormous number of our daily actions have become automatic, so that nobody could actually recall in all their details the actions of a day in his life. It is as if consciousness had so much that is fresh and untried to concern itself with that it cannot be troubled to take notice of every-day occurrences. Can any man remember, except with the greatest difficulty, the exact procedure he adopted in getting up and dressing in the morning? He has become so familiar with the act of dressing that many of the details are performed practically without "thinking." But that there are pathways leading from the automatic circuit to the higher seat of consciousness is shown by the fact that an action that has become automatic may become conscious as soon as the attention is fixed upon it. The central nervous system is stored with countless numbers of tracks concerned with actions that have become habitual. Often the habit has

been acquired with great labour, and has necessitated profound attention. For instance, in learning to read music every sign on the page must be attended to. Later on, when skill is sufficiently developed, the actual markings on the page of music are hardly noted by consciousness. The ease with which impulses flow through habitual tracks render such a disease as chronic alcoholism extremely difficult to treat. The sight of a glass of beer may almost compel the drunkard to reach out his hand and take it.

In the brief summary which has been attempted of the physiology of the central nervous system, an endeavour has been made to show that the primary fact is the motor response to a sensory stimulus, such as is seen in single-celled animalcules. As the body becomes more complex and differentiated, the motor response is brought about by impulses conveyed from a sense organ or a cell of some kind through an afferent nerve fibre to a central nerve ganglion containing nerve cells. Thence the impulse is reflected through a motor nerve to such animal cells as are required to act. The conveyance and elaboration of the impulse seem to be of the nature of chemical processes. The machinery for this reflection of impulses is described as a sensori-motor arc, and consists of relays of cells with long axis-cylinder processes and short dentrites. The nervous systems of the

higher animals are built up of a vast number of series of sensori-motor arcs. The passage of impulses through these arcs may be simply reflex or automatic, and need not necessarily affect consciousness. The paths may become so well-worn that the action takes place easily and rapidly without attracting attention. But the passage of the impulse is not a mere uncontrolled reflection; there is an inhibiting or controlling influence exercised by other parts of the nervous system, permitting the channels or pathways for the passage of the impulse to be opened only to a certain extent or in a certain way. The higher we proceed in the central nervous system the more complex becomes the interaction of the sensori-motor arcs, and the more numerous the association fibres connecting neighbouring areas. The most complex portion of all is the cerebral hemispheres. Through the grey matter on the surface or cortex of the hemispheres the mind of the individual expresses itself in action, and consciousness is attained. The sensations which lead to consciousness fix the "attention" to a greater or less extent; the repeated passage of an impulse through the same pathway is called "memory"; association nerve fibres between different areas of the cortex assist in the production of "ideas"; the particular tone given to sensations in consciousness produces "emotions"; the complex course of

conduct which ultimately emerges is ascribed to the "will." And the sum total of the permutations and combinations of all that is meant by these terms in each individual is the "Ego." But the definition of the "Ego," and the application of such terms as "will," or "consciousness" are not matters for the physiologist. It is the work of the psychologist and of the moral philosopher to explain as far as he can that which is at present, and possibly may always remain, incomprehensible.

CHAPTER III

GENERAL REMARKS

Psychology has been variously defined, and though definition is more properly the end of a science than its beginning, some indication of its subject-matter and scope must be given at the start. In the Introduction we have called it the study of personality in all its aspects, and if this be interpreted as the study of *behaviour*, the definition is satisfactory. A clearer idea of the special work of the science will be given by marking its distinction from other fields of inquiry.

Psychology is distinct from ethics in that it has no concern with *standards* of conduct and ends of human action ideally constructed (except so far as the ideas of such standards and ends are parts of mental process), but deals only with the *facts* of conduct as observed, and with their explanation.

From Logic it is differentiated by its treatment of thought and the intellectual processes. Logic treats of *valid* thought and the conditions necessary for the acquisition and communication of truth. Psychology is concerned with Thought

as a mental fact, and with its process as a part of mental activity. The question for Psychology is, How do we think? What do we do when we think? while Logic is concerned with the question, how to think *rightly*. To Psychology fallacious reasoning is as interesting as valid inference; thought, not the truth of thought, being the object of its inquiry.

Psychology *assumes* its subject-matter, the "I" of Descartes' "Cogito, ergo sum," and the world as commonly understood, endeavouring to ascertain how we become conscious of ourselves and this world, in what manner we resolve the Universe into "Self," and "*Not*-Self," "I," and all that is without the "I." This marks the distinction between Psychology and Metaphysics (or, more strictly, epistemology) which seeks to explain the world and to discover the ultimate construction of reality.

From one of the physical sciences, Physiology, with which Psychology has very close relationship, it needs to be clearly distinguished. Physiology deals with the *machinery* of personality, the *physical* processes of behaviour, the nerves, muscles, cells, and tissue, which are the material clothing, the means of action and communication of the individual. But it is not concerned with these as manifesting behaviour, or as representing the reaction of personality to its environment.

That is the domain of Psychology. Physiology is interested only in the physical construction and relationships of the parts of the body as such, not as being the modes of action of a mind. So much of the physical phenomena as is necessary for understanding the operations of the mind is usually included in textbooks of Psychology.

Though we have thus marked off our science from others, it must be noted that these distinctions are merely for the convenience of investigation and record. It would be impossible to inquire into life as a whole. Hence we divide up the subject and consider it under various aspects, as in Biology, Zoology, etc. Although the tendency at present is to a faith that all knowledge will be found summed up in one complete science, which will be a philosophy, we must, until we have discovered this *scientia scientiarum*, divide into many separate sciences the great problem of life. Each of these sciences takes for granted the work of the others, and does not investigate their results. Thus Psychology takes from Physiology its physical facts, from Logic its method, leaves the question of standards of conduct to Ethics, and assumes the existence of a world which Metaphysics strives to establish or disperse.

Terms. — We have already used the word "mind," and the ambiguity of the term brings

up a question very important in all sciences, but especially in those relating to conduct as contrasted with appearance—the question of terminology. Even in the physical sciences, which describe what can be seen and touched, special terms, technical nomenclatures, have to be employed to embody and communicate the facts to be recorded. But in the mental sciences we are dealing with the operations of a mind which cannot be seen or touched or measured by the physical senses. To describe these operations we have only the terms of everyday experience relating to material things, the objects of sense perception. The application of these terms, hackneyed by common use and obscured by association with all kinds of things not strictly connoted by them, has been found incompatible with the clearness and precision of the physical sciences to whose subject-matter such terms especially apply. Much greater, then, is their unfitness for use in sciences whose subject-matter is alien to them. But to invent a whole series of new terms for processes which have been discussed in familiar speech is to deprive the science of its apparent relation to life, and to disgust and weary the beginner. A mean must be sought by which precision may be obtained, and separation from life avoided. In Psychology the compromise has been much in favour of the common speech,

though in later years as experiment has been increasingly brought into service, special terms have been more used. A few appropriate terms, such as Perception, Cognition, Conception, Conation, Sense, Association, etc., have been given scientific definition, and restricted to Psychology; but their number is small, and there is not complete agreement as to their significance. Generally, the science of behaviour is expressed in terms of ordinary intercourse, rich in association, and blurred by metaphor. The dangers of this course are great, and should be noted at the outset, though full appreciation of their importance comes at a later stage. With such terms it is difficult to secure clearness, and almost impossible to obtain the definite divisions of an effective classification. Want of precision in language means confused thinking and doubtful conclusions. The use of words proper to material and mechanical phenomena and activities for the sciences of mind and conduct, give to these a material and definitive character which is not really theirs, and tends to prejudice important questions as to the real nature of these processes by giving them a mechanical aspect. For example, Psychology suffered long from fallacies due to misuse of the word "faculty," mind being credited with "faculties" of seeing, hearing, thinking, etc.; all separate, working apart, and with different

nerve centres and means of activity (see also p. 81). Similarly, material terms led to the conception of memory as a place, an aggregation of pigeon-holes in the brain, in which facts were stored, to be brought out by a happy association when needed.

The use of ordinary terms tends also to confuse the student on beginning his work, since he is forced to clear his mind of various meanings of words which have by custom become associated with them, and attend only to the significance of the terms for Psychology.

MIND.—Thus the word "mind" has many meanings, and has been variously interpreted. The Greeks, making no distinction between soul and mind, called the former "psyche," and from this is derived the title of our science—Psychology—a discourse concerning the soul or mind. What was meant by this term is not clear, and has been obscure throughout the history of thought. Nor is this strange, for the soul has always been considered the essentially human part of man, that which distinguished him from the brute, and allied him with the divine; so that a satisfactory definition of the mind can only follow a full definition of life and man's part in it, a consummation not readily attainable.

It may be interesting to trace a little of the history of "mind" in speculation. Plato among

the Greeks conceived it as something apart from the physical man, though for a time embodied in human form. It lived before and after the individual in whom it found temporary habitation, being the animating and rational spirit clogged by the weaknesses of the body, and striving for "the good." Aristotle, whose treatise "of the soul" is generally regarded as the first work of importance to Psychology, did not attempt to *describe* this soul, but treated it rather as the sum of the life-functions of the individual, professing no knowledge as to whether these peculiar functions which characterize the living as compared with the dead were possessed by a separate entity, capable of a distinct existence. The question was debated through the Middle Ages, the general view tending to Plato's conception of an entity capable of separate existence, but possessing the functions described by Aristotle. This led rather to a neglect of the bodily functions in which the soul is expressed, and to concentration on the higher, or purely rational, activities of the soul, culminating in Descarte's description of man and animals as purely *mechanical* things (*brutes machines*); but man distinguished by the possession of a soul, exercised only in intellectual activities. The rapid progress of the physical sciences now led men to emphasize the material aspect, and to inquire

why a soul need be predicated at all, why a man should not be regarded simply as a more complex animal? From this sprang the scepticism of the eighteenth century, and especially the aggressive scepticism of the Encyclopédists. The idealists fell back upon revealed religion (Locke), or a subtle analysis of the material phenomena (Berkeley), for defence of the soul.

Kant following Berkeley, by showing that our perception of physical reality is conditioned by the character of our sense organs, and that the reality we perceive may be in itself something quite different from our perceptions—is, in fact, rather an indication of the construction of our own minds than of any external reality—offered a way of escape from materialism, at the same time maintaining that the "moral law" in man, before which he (Kant) stood in reverent contemplation, justifies a belief in the existence of the soul as an immortal, super-sensible being.

These remarks indicate the fluidity of meaning of the terms Psychology is forced to use, and also show how necessary to any theory of the universe is a sound psychological basis. The ends of knowledge, not its means, are what men seek; but unless the means are investigated and understood (the province of Psychology), we are unable to appreciate what we know, or to realize its significance in reference to the world we live in.

CHAPTER IV

METHOD

The methods of investigation open to the psychological inquirer are roughly four:

1. Introspection.—The inquirer may note his own states of mind, may endeavour to discover what goes on in his mind when he responds to the environment in which he is placed. Thus, he leaves his house to catch his train to the City. This action is dictated by the necessity of earning his living, and therefore conforming to certain rules in order to attain that end. It is part of his general plan of life, and receives its prompting from the higher nervous centres. But the actions of walking, of swinging the arms, of avoiding collisions, are largely automatic or reflex, not related to energies of the thinking brain, but immediate, instinctive responses to sensations of touch or sight. He sees a man approaching, and instinctively he moves aside. The sight of a neighbour reminds him of his domestic difficulties, or of disputes as to the predations of dogs. His mind follows this line of thought to

possible legal remedies, inconveniences of life in large towns, neighbours he used to have in other places, and so on. The investigator, by thus watching his mind's workings, can learn much; but he must remember that the mere fact of attending to the perceptions or conations of the moment at once alters the mental situation. A new factor has been added—that of attention to the mental machinery—and this new factor affects the phenomena observed. Thus, what the inquirer notes consciously is different from the process which was at work *before* the factor of conscious observation was added. This difficulty is partly counterbalanced by number of observations. One may note mental processes without number, and so arrive at what is essential to them all, and allow for the effects of conscious introspection. Again, one can compare the results of such introspection with the recorded results of other investigators. Further, training and practice are capable of making great improvements in the introspective, as in all other modes of observation.

Retrospection is free from the objection that attention to the working of mental process tends to arrest the process itself by withdrawing attention from the object of the process. By calling up a process in memory immediately it is over, we can analyze it with greater success than by

introspection at the moment of activity. Thus, in recalling an angry dispute, one can note how the mind worked, how one particular phrase roused irritation, how irritation found an outlet by the use of statements or innuendos calculated to wound the opponent, how gradually the desire for truth was overwhelmed by the desire for victory or the wish to hurt—to a much fuller degree than is possible during the actual strife.

2. Observation of the Mental State of Others.—Practically all mental states have a corresponding physical process, and this physical process is observable by the investigator, who, aided by the results of self-introspection, can deduce from the physical appearance the mental process. Thus, if we observe a man grind his teeth, flush, stamp, clench his fist, we know he is angry, partly because such signs have accompanied personal angry feelings in ourselves, and partly because persons yielding such signs have told us they were under the influence of passion.

We can also observe the actions of animals, children, and savages, though care must be taken in deducing from the actions of undeveloped beings the same mental process as would have accompanied such actions in a highly-civilized man.

Taking necessary precautions to avoid error, much can be learnt from this kind of observation,

and from the communications of others verbally, or in biography, as to their mental states and the manner in which their minds have moved in cases of invention, emergency, imagination, and the like.

3. Observation of Pathological Cases.—This is one of the most fruitful methods of psychological inquiry. The investigation of cases of colour-blindness, partial or total loss of memory, deafness, hallucination, lunacy, afford information of the greatest value. Here we get those cases of difference from the ordinary, which are to Psychology what experiment is to physical science—observation of phenomena under specially limited conditions. Much light is thrown on mental development by the consideration of such abnormal cases as Laura Bridgeman and Helen Keller, and there is a growing feeling that the richest field for the psychologist is the hospital.

4. Experiments.—The immense strides made by physical science have naturally led psychologists to attempt similar advances in the domain of the mind by the aid of the most potent instrument of physical investigation—experiment. In the last twenty years much, especially in Germany, has been done in this direction. Examples of experimental methods in Psychology will be found in various portions of this book, but a general description should be given of the course

so far pursued, and for this no words are better than those of Professor James ("Principles of Psychology," chap. viii., p. 193):

"The principal fields of experimentation so far have been—(1) the connection of conscious states with their physical conditions, including the whole of brain physiology, and the recent minutely cultivated physiology of the sense organs, together with what is technically known as "psychophysics," or the laws of correlation between sensations and the outward stimuli by which they are aroused; (2) the analysis of space perception into its sensational elements; (3) the measurement of the duration of the simplest mental processes; (4) that of the *accuracy of reproduction* in the memory of sensible experiences and of intervals of space and time; (5) that of the manner in which simple mental states *influence each other*, call each other up, or inhibit each other's reproduction; (6) that of the *number of facts* which consciousness can simultaneously discern; finally (7) that of the elementary laws of oblivescence (forgetfulness) and retention. It must be said that, in some of these fields, the results have as yet borne little theoretic fruit commensurate with the great labour expended in their acquisition. But facts are facts, and if we can only get enough of them, they are sure to combine. New ground will from year to year be broken, and theoretic

results will grow. Meanwhile the experimental method has quite changed the face of the science so far as the latter is a record of mere work done."

The above statement of the methods of psychological inquiry will have indicated the data to which those methods can be applied. Every object in earth or sky or sea is, or can be, the object of mental process, and so a datum of psychological inquiry. Since the science is largely a study of the activities by which the external world is revealed to man, and he becomes conscious of himself and of that world, there is nothing which cannot be said to fall within the methods of inquiry open to the science. The more special objects of interest to the psychologist have been referred to in the remarks on Method.

CHAPTER V

SENSATION

The special sense organs at the periphery will be described separately, but the general operation of sensation may usefully be stated here.

The stimulus takes place at the surface of the body (the periphery) and by afferent (incoming) nerves is conveyed to the higher centres, where the sensation is experienced and action evoked. This action is conveyed from the brain to the muscles concerned by efferent (outgoing) nerves, and muscular contraction follows. To these three stages correspond respectively sensation, ideation, and motion. The brain may be described, roughly, as a mass of white matter enclosing greyish nuclei, and with a sheet of grey matter covering its folds and convolutions. This outer sheet of grey matter is the cortex of the brain and is of vital importance for consciousness. Only so far as nervous processes are in connection with the cortex are they conscious.

Below the cortex are the subcortical processes (the cerebellum), the upper part of the spinal cord

(the medulla oblongata), and the spinal cord itself. The muscles and surface of the body are connected with the spinal cord, and strands of nerve fibre pass upwards along the cord itself to the subcortical centres.

These subcortical portions of the nervous system serve to convey and modify impulses passing between peripheral organs and the cortex; but they also discharge functions independent of the latter. They are organs of *reflex action—i.e.*, action which responds uniformly and inevitably to certain external stimuli. The response is uniform and inevitable only if it is not interfered with by other external stimuli, or by processes going on in the cortex. The characteristics of such action have been worked out in detail in Chapters I. and II.

These purely reflex actions lack spontaneity—*i.e.*, they depend on the external stimuli for their origination; and they are uniform and inevitable, not modified by past experience. The same stimulus is followed always by the same action. Whether such purely reflex actions are devoid of consciousness or not is a question much debated; but it is clear from experiment that the workings of the subcortical mechanism are capable of taking effect without processes in the cortex.

The world presents itself to us through our

senses—sight, hearing, taste, smell, and touch. Without these we can know nothing, but in themselves they do not do more than produce mechanical impressions which must be attended to, grouped, interpreted, distinguished, by the mind of man.

It has, indeed, been doubted whether there is such a thing as a *mere* sensation, the simple impinging on a sensitive organ of some mechanical force like a wave of light. Certainly, by the time we are old enough to think of them, sensations are far from simple or "pure." A sensation, then, is coloured by all that we have learned and done. The sight of a glass of milk is at once bound up with all that we have experienced or read or heard of such things—their character, taste, feel, constituents, uses, prices, and an infinite variety of similar inchoate but existent impressions. If, indeed, we did not instantly refer the sensation to previous similar sensations which were followed by certain experiences (*i.e.*, *other* sensations), how could we *recognize* the object in a glass of milk? It could have no *meaning* to us, but be simply a physical fact—whatever that is.

Using subject to denote the individual receiving sensations, and object to denote the source of the sensations, it is to be noted that such objects are, in ordinary sensations, apprehended as exterior

to the body, and as extended in space if objects of sight. Whether this placing of objects in space, and exterior to the subject, is due to the action of the *mind*, which first apprehends the sensible qualities in itself, and then projects them by an intellectual or supersensational mental act, has been much discussed in Psychology. There do not, however, appear to be sufficient grounds for this opinion. The first sensation the infant gets is for him the external universe. He becomes conscious of a something which affects him. The sensation is vague and blurred, bringing to his consciousness an object which is for him, as James says, "one big, blooming, buzzing confusion." That is his world, and his sensations appear to come therefrom. Even his own body, which bit by bit he explores by touch and sight, is experienced as an external object, until the difference between it and disparate objects is called to his attention by the fact that the latter yields *one* set of sensation (*e.g.*, those of touch on the hand), while the former yield a double set—*e.g.*, those of touch in the exploring hand, and also of touch in the part of the body explored.

Consciousness.—We have used the word "consciousness," and must indicate the difference between this and sensation, to which so far we have restricted attention. It must be said at once that no definition of consciousness—in the scien-

tific sense—is possible. Sensation as a physical fact is *physiologically* possible even in the absence of consciousness. Consciousness may be described as the state of awareness of sensations, or experiences, as states of the self. It is the mental correlative of the physical alteration of nerve fibres and brain matter which are the physiological machinery of sensation. It is not, however, a separate thing from sensation, but *includes* it. It is "the common and necessary form of all mental states. . . . It is the point of division between mind and not mind."* "What we are when we are awake, as contrasted with what we are when we sink into a profound and perfectly dreamless sleep, *that* it is to be conscious. What we are less and less, as we sink gradually down into a dreamless sleep, or as we swoon slowly away; and what we are more and more as the noise of the crowd outside tardily arouses us from our after-dinner nap, or as we come out of the midnight darkness of the typhoid fever crisis"†—*that* is consciousness.

The question at once arises, What is the connection between sensations physiologically considered and consciousness? Why does a ray of light of a certain wave length produce a consciousness of *red*, and a wave of greater length

* Baldwin, "Elements of Psychology," p. 57.

† Ladd, "Psychology: Descriptive and Explanatory," p. 30.

a consciousness of *green?* Why does a sound, or a succession of sounds, give a consciousness of music? Can we discover a causal nexus between the stimulation of nerve fibres and our consciousness of life and the wonder of natural phenomena which sensations yield us? The question is difficult, and not to be determined within the limits of Psychology, but falls into the domain of ontology—the study of the nature and essence of the universe. But, since serious students would be deeply interested in the matter, some indication of the lines of solution may be given.

Three principal hypotheses have been put forward—of Interaction, Direct Causation by mind or by matter, and Psycho-Physical Parallelism. The Interaction hypothesis suggests that just as a nervous change may produce muscular movements, so a cerebral change (a change in the matter of the cortex) may produce a state of consciousness, and that a conscious process, such as *will* (volition) may act on the cortex and thence on the muscles, producing muscular activities. This, however, is contrary to all our ideas of causation. We explain, scientifically, by resolving a complex phenomenon into its parts or causes, which are known. But this is possible only when there is clear connection between the causes and the phenomenon—*i.e.*, where they are parts of one and the same continuous process. If the phenomenon

differs in kind from the causes alleged, there is no explanation, but simply a solution of continuity. This is precisely the case in the instance of mind or consciousness and matter. Consciousness is not an aggregate of material causes, a complex of nerves, muscles, and sense organs, but something quite different. For interaction there must be analogy, something in common between the thing acting and the thing acted upon, and to explain consciousness and sensation by such an hypothesis is to abandon the slowly attained scientific conception of causation. It is to explain an unknown subject by alleging a unique process. This is logically inadmissible. It is not explanation, but the statement of a miracle.

The hypothesis of one-sided causation, which, where it gives predominance to matter, alleging it as the cause and fountain of consciousness, has attained wide repute as "materialism," is still more open to attack on similar grounds.

The third hypothesis is psychologically not an explanation, but a formulation of the facts without assigning the causes. Psycho-physical parallelism simply states that modifications of consciousness emerge simultaneously with corresponding changes in nervous process. The external stimulation which gives rise to a sensation may be regarded as the cause of that sensation, since it is the cause of the cortical process which

accompanies the change of consciousness. Similarly, the act of volition which results in a contraction of muscles may be regarded as the cause of the contraction, since it is correlated with the cortical process which sets the muscles in action. This is a statement of facts only. For the explanation of these facts the hypothesis goes to ontology—the theory of the nature of the universe. Briefly, it is held that just as the brain is a part only of the material universe, so the stream of consciousness of the individual is part of an immaterial system. Now what makes matter material is certain experiences of the minds knowing matter, by way of sensations. In other words, the properties of matter are constructions of the minds which have received the sensations. Thus the attributes of matter (extension, hardness, weight, colour, etc.) depend on the mental constitution of the individuals knowing, or "cognizing," matter. So far, then, as matter is known as matter, it depends upon the mind, or system of immaterial agency. Its *existence* does not so depend, for we do not *make* matter, but so far as matter exists independently of its attributes as matter, it has no material properties, and is simply an agency which is an essential condition of material phenomena without being itself a material phenomenon. Thus the world of material phenomena presupposes a system of

immaterial agency, and in this immaterial system the individual consciousness originates.

This hypothesis, thus briefly stated, is probably the most useful as a working basis, as it covers the known facts and escapes the difficulties of the interaction theory.

CHAPTER VI

MODES OF CONSCIOUSNESS

This mental development we are to analyze is present to us as a stream of consciousness, a never-ceasing succession of "psychoses,"* or mental states. The external universe, of which we propose to study the intellectual construction, is a continued series of presentations (a "presentation-continuum"), which yields sensations. These sensations evoke certain feelings (have an "affective" tone); we are pleased, displeased, or otherwise disposed towards the object presented, and experience a tendency to act upon or in consequence of the object, to alter or transform it, to bring it more fully into consciousness or the reverse. This gives us the three fundamental modes of being conscious—*knowing*, *feeling*, and *striving*, or, as psychologists say, *cognition*, *feeling*, and *conation*. We cognize a presentation—that is, we grasp its meaning, its relations to our life and the world; this knowledge affects us, and

* *Psychosis*=total state of consciousness as existing at any one moment.

prompts to action. With the action new sensations, new presentations, arise, and the same process is repeated. So through life we learn our world, and our position in it; are pleased or displeased, try to alter or maintain it, and the activity so brought about leads on to further presentations, feelings, and strivings. What the ultimate end of this process is, Psychology cannot say, but for practical purposes Herbert Spencer's formula, that the essence of mental life and of bodily life are one—namely, "the adjustment of inner to outer relations"—has been of the greatest use in the science. Just as the unconscious acts of the Amœba are seen biologically to tend to adjustment to environment and preservation of the species, so the conscious mind processes of the highly civilized human being may be considered teleological—that is, to be what they are, because of their utility in shaping his reactions to that outer world in which he lives and moves and has his being.

CHARACTERISTICS OF MENTAL PROCESS.

Of this stream of consciousness, this constant succession of mental states, certain qualities, upon which depend the apprehension of the universe and the whole structure of intellectual life, are to be noted.

Law of Relativity.—One of the first things which introspection reveals to us is the existence of variation—difference—among the presentations or ideas experienced. This is a vital step to knowledge. Until that "big, blooming, buzzing confusion" we have referred to as the baby's first sensational experience has been to some extent differentiated; until the sensations of sight have been found different from those of touch, and, again, from those of hearing; until the bodily sensations (of viscera, stomach, etc.) have been localized and discriminated from the sensations due to stimuli from entirely external objects—the confusion is not ordered, nor the mental darkness illuminated. In fact, without variations in the presentations or ideas, consciousness *ceases*. As Hobbes long ago stated the fact, "Semper idem sentire ac non sentire ad idem revertunt" (Always to feel the same and not to feel at all, amount to the same thing). Consciousness is a continuing process, not a static fact. Fix, for example, your eyes on a blank wall, and determine to keep the mind intent upon the wall and its blankness entirely. It will be found that after some seconds the mind begins to follow out cracks in the wall, to compare its appearance with other walls, to make hypotheses as to its composition and purpose—to do anything but remain fixed in the presentation of the blank

wall. If the effort is persisted in with sufficient strength of will, a blankness of the mind, a state of coma or hypnotic trance, supervenes. The request of the hypnotist to his patient to fix the mind intently on a bright coin or other such object is done precisely with the intention of rendering negligible the mental life of the patient, in order to substitute for it the presentations or ideas willed by the operator.

It is to be observed that this difference in presentations or ideas is not the same thing as difference in the object presented. Thus an orange may be the object presented to the senses for a considerable time without change, but the presentations in consciousness are continually differing and varying, though the object remains the same. The mind plays about the object: at first its goodness, juiciness, smell, are noted; then personal likes or dislikes are revived; then ideas as to the giver or as to the purchaser of the orange; meditations as to its growth, country of origin, and the like succeed; and so the process continues until the object is removed, or the mind turns to something else. The mind does not rest in the simple contemplation of the object, and though that may remain the same, consciousness continually alters with regard to it.

The whole of mental life is, to a great extent, the gradual perception of difference in objects

previously thought alike—a process to which has been applied the name of *analysis:* the resolution of phenomena into their constituent parts, as a chemist breaks up a salt into its elements. Side by side with this process is, however, another, that of *assimilation*, by which similarity is perceived between objects previously thought entirely different. On these two processes, the perception of difference and of agreement, rests the whole of science, with its classifications and biological trees; for these are nothing but the records of observed similarities and differences.

As Dr. Ward observes: "Psychologists have usually represented mental advance as consisting fundamentally in the combination and re-combination of certain elementary units, the so-called sensations and primitive movements; in other words, as consisting in a sort of "mental chemistry." If we are to resort to physical analogies at all—a matter of very doubtful propriety—we shall find in the growth of a seed or an embryo far better illustrations of the unfolding of the contents of consciousness than in the building up of molecules: the process seems much more a segmentation of what is originally continuous than an aggregation of elements, at first independent and distinct.

One important aspect of this variation of consciousness, this constant change of presentation,

is the Law of Relativity. Bain states it thus: "As we neither feel nor know without a transition or change of state, every feeling and every cognition must be viewed in relation to some other feeling or cognition. There cannot be a single or absolute cognition." Höffding's statement is: "From the moment of its coming into being, the existence and properties of a sensation are determined by its relation to other sensations"—adding that the law applies to all ideas and concepts, and to feeling and volition.

Wundt uses a different form—"That we apprehend the *intensities* of stimuli not according to any fixed unit given along with or before the impression itself, but in general only according to their mutual relations." Or, more vaguely "we feel all things in relation to each other."

It is certainly true that the more we have to attend to, the less capable we are of noticing other matters. Cases have occurred where the soldier, in the heat and excitement of the battle, has not noticed a wound. Engaged in a close game of chess, one does not notice the dying out of the fire. The psychical effect of incoming nerve currents does seem to depend on what other currents may be pouring in at the same time. The explanation would appear to be a physiological one — that one current interferes with

another, and as a result of the interference sensations are modified.

"Examples of the modification in question are easy to find. Notes make each other sweeter in a chord, and so do colours when harmoniously combined. A certain amount of skin dipped in hot water gives the perception of a certain heat. More skin immersed makes the heat much more intense, although of course the water's heat is the same. Similarly, there is a *chromatic minimum* of size in objects. The image they cast on the retina must needs excite a sufficient number of fibres, or it will give no sensation of colour at all. Weber observed that a thaler laid on the forehead feels heavier when cold than when warm. Urbantschitsch has found that all our sense organs influence each other's sensations. The hue of patches of colour so distant as not to be recognized was immediately, in his patients, perceived when a tuning-fork was sounded close to the ear. Letters too far off to be legible could be read when the tuning-fork was heard, etc.

"*Effects of Contrast.*—The best-known examples of the way in which one nerve current modifies another are the phenomena of what is known as 'simultaneous colour-contrast.' Take a number of sheets of brightly and differently coloured papers, lay on each of them a bit of one and the same kind of grey paper, then cover each sheet

with some transparent white paper, which softens the look of both the grey paper and the coloured ground. The grey patch will appear in each case tinged by the colour *complementary* to the ground; and so different will the several pieces appear that no observer before raising the transparent paper will believe them all cut out of the same grey. Helmholtz has interpreted these results as being due to a false application of an inveterate habit — that, namely, of making allowance for the colour of the medium through which things are seen. The same *thing*, in the blue light of a clear sky, in the reddish-yellow light of a candle, in the dark brown light of a polished mahogany table which may reflect its image, is always judged to be of its own proper colour, which the mind *adds* of its own knowledge to the appearance, thereby correcting the falsifying medium. In the cases of the papers, according to Helmholtz, the mind believes the colour of the ground, subdued by the transparent paper, to be faintly spread *over* the grey patch. But a patch to *look* grey through such a coloured film would have really to *be* of the complementary colour to the film. Therefore it *is* of the complementary colour, we think, and proceed to *see* it of that colour.

"This theory has been shown to be untenable by Hering. The discussion of the facts is too

minute for recapitulation here, but suffice it to say that it proves the phenomenon to be psychological—a case of the way in which, when sensory nerve currents run in together, the effect of each on consciousness is different from that which it would be if they ran in separately" (James).

The Law of Relativity is not to be interpreted as Bain did, to the effect that sensation is *nothing* but differences or contrasts. All we know of B is not only that it is the difference between X and Y, but also those qualities which make the object stand for something apart from consideration of X and Y. The objects of the sensations *do* count for something, but the sensations are modified by those which accompanied and preceded them.

There is, it should be noted, a relativity not merely due to the simultaneity or successiveness of sensations or presentations, but due to conscious will. Thus the series of movements in a game of chess is a conation, in which the various moves are related and affect one another in obedience to a directing mind seeking a certain end. If an interruption occurs in such a game, the state of consciousness with which the player returns when the interruption is over is rather a continuation of, and affected by, his mental state before the interruption than a result of the consciousness immediately preceding such resumption of play.

Such relativity and continuity as this is a part of the active, conative side of mind, and does not depend upon proximity of the sensations, but upon the direction of the mind to a definite end or purpose.

2. The second quality of consciousness which it is important to note is its UNITY and CONTINUITY —its grouping of the various impressions by a knowing subject. Mere change in the contents of consciousness is not sufficient for the creation of a world. These changes must be grouped, related, and brought into connection with previous presentations. They must also be unified by being states of mind of one abiding personality.

What is this subject which experiences the sensations and whose life is consciousness? It is not for the psychologist to do more than assume such a subject. To Metaphysics may be left the question of its ultimate nature, but the assumption of its existence is forced upon our science. The naïve view of the ordinary man—that there is, on the one hand, an objective world capable of yielding sensations; and, on the other, a subject capable of experiencing them—is a satisfactory working hypothesis for us. Consciousness implies that there is a subject knowing as well as an object known. States of feeling occur to a subject, and it is only their occurrence to the

same subject that makes them a series. All knowledge implies a knower.

PSYCHOLOGIST-SUBJECT.—Psychologists have, for convenience of analysis and exposition, evolved a psychologist-subject—a mind capable of receiving impressions entirely fresh, with nerve fibres and brain matter unmodified by heredity. In actual life, of course, no man begins at the beginning. Many of the acquisitions of the race, slowly and painfully won by generations from the first sentient thing to our own day, are ours, not by our own conscious mental construction, but by modification of tissue and fibre and brain before birth. "What was experience in the past has become instinct in the present."

ASSIMILATION.—The activity of this subject in arranging, combining, analyzing, and interfering with the impressions received is known as "Assimilation." As Spencer says: "In being known, each state must become one with certain previous states—must be integrated with these previous states." Assimilation is the complement of differentiation in the development of the mind. Unless a presentation is linked up with preceding ones, it cannot be known at all. An *entirely new* presentation, not connected with any previously experienced, would simply be a miracle, and would unseat the mind experiencing it. Most people have known the feeling of utter bewilder-

ment, of other-worldness, of unreasoning fear, produced by presentations which are not consonant with the immediately preceding ones—*e.g.*, by accident you enter your neighbour's house instead of your own. For the second that elapses before you grasp your mistake, the unfamiliar sitting-room and strange appearance of everyone completely bewilder you. Much greater, if such were possible, would be the shock if *nothing* in the presentation had any connection with previous psychoses—if the house were a "house not built with hands," the people unthinkable creatures of an unknown maker, the room "fourth dimensional," the furniture unrecognizable. Practically, this is not possible. No presentation is entirely new. Generally, presentations are a modification of the mental state existing immediately before; always they have relation to some states previously cognized. With these the subject integrates them, compares, classifies, modifies its previous conception of similar objects, and uses its new knowledge in its further activities.

In this assimilation, again, it is the conative aspect that is most important for mental development. The mind, in view of some end it has proposed, concentrates upon and assimilates those qualities of presentations which tend most to serve the end desired rather than the qualities merely contiguous in time and not bearing upon this end.

Associationism.—In dealing with the integration or assimilation and differentiation of presentations, we have taken the view that these are due to the activity of the mind itself. This is the general modern view as contrasted with the hypothesis of earlier psychologists (*e.g.*, Bain, Mill, and Spencer in England, and Herbart in Germany), that the integration is somehow due to the impressions themselves, and that they act in this way because it is their nature to do so, just as atoms of matter are attracted towards each other by the forces of gravity, cohesion, chemical affinity, and so on. As words are built up by the letters of the alphabet, each of which appears in the result, so mental states are a compound of sensations, images, and ideas mechanically brought about by attraction and repulsion among the presentations themselves. Thus they would say the perception of an orange wholly consists in the more or less complete reinstatement of past sensations by the present sensation, which forms the nucleus for a cluster of revivals, each of which exists in the final state of mind—that of perception of an orange. This is not the case, as careful introspection shows. Some measure of association and reproduction is certainly involved in mental development. The defect of the theory lies in making the process *merely* reproductive to the exclusion of other modes of psychical

interaction, giving rise to new and not merely reproduced results. What we note in examining our perception of an orange is not a number of presentations revived by and added to the actual sensations of the moment. Brought to the test of careful scrutiny, seeking whether the mode of consciousness alleged to consist of certain constituents, *a*, *b*, and *c*, is so made up, the explanation of the Associationist school collapses. A certain smell, a certain touch, a certain taste and appearance, etc., added together, do not give us the presentation of orange. There is something more in the *process* of mind and something less in the *content* of the process than is indicated by the theory. The something more is the activity of the mind, which, working on the presentation, gives it its import and significance, and which has resolved certain elements into a new presentation, binding them up into a new whole, different from a mere aggregations of the parts—the new whole, which is known as the concept or idea of "orange." Mental life would be inconceivably hampered if it were not for this summarizing power of the active mind. If all the characteristics of an orange were present in consciousness when we have the idea of orange or other object, we should be too burdened for much progress, and the disability would be greater in handling more complex ideas, such

as "state," "goodness," and the like. This concentrating and excluding or abstracting activity gives a new product, which is equivalent in the realm of psychology to *words* in discourse. Just as we can talk of such matters as "gravitation" by the use of a single word, without the necessity of a detailed statement of all that is involved in the theory, so the activity of the mind gives us a perception which is enriched by the result of all that has gone before in the way of previous experience, but is not hampered by the express reproduction of all such previous experience.

Mill was so conscious of the weakness of the Associationist theory as an explanation of all mental phenomena, that he modified it by a theory of "Mental Chemistry," by which the idea of an orange is *generated* from the simpler presentations of smell, etc. He still, however, neglected the activities of the mind, and held to the existence in the idea of all the elements which have gone to its formation.

The Faculty Theory.—Untenable as an explanation of mental process, the Associationist theory has done good work by drawing attention to the importance of reproduction in mental life, and by discountenancing the older "faculty theory" of mind. This theory gained credence before scientific explanation was thoroughly understood. We explain a fact by showing it to be

a result of other facts, an example of the working of certain laws. We explain by *causation*. This states a relation between the result and its cause, and in the absence of such relation or connection there is no explanation. An effect cannot be its own cause, but it is a not uncommon fallacy to state as cause something which on examination turns out to be the effect itself stated in another way usually in more general terms. If in answer to the question, "Why is Brown so fat?" it is replied that it is "because he has so much adipose tissue," it will readily be seen that this is no explanation at all, but simply another way of stating the fact of stoutness. There must be a relation between the fact to be explained and some OTHER fact which determines it.

Psychology is especially liable to this fallacy of explanation or "argument on a circle." It has assumed the form of referring mental states to a corresponding "faculty." To say that a voluntary decision is due to Faculty of Will, that mental processes in man are due to a Faculty of Reasoning, that Conscience is a Compound Faculty having the power of judgment and of feeling, is futile as explanation. "We may as properly say that it is the singing faculty sings, and the dancing faculty dances, as that the will chooses or the understanding conceives" (Locke).

To allege a faculty is merely to state that there

is a possibility of a process, a power of carrying on a process. To say the power of carrying on the process is the cause of the process is argument in a circle, mere failure to explain at all. Real explanation by definite conditions giving rise to definite results, according to a fixed order, should be insisted on by the student.

The idea of "Faculties" is useful, however, as a basis of *classification* of phenomena, without any causal implications.

Attention.—A name for the activity of the subject by which it becomes conscious of presentations, and by becoming conscious of them heightens their effect in consciousness, is Attention. It is a little anterior to the processes of differentiation and Assimilation, and may be said to be the medium in which they work, the limited field in which their activity is permitted. For it is one of the extraordinary characters of mental life, that of all the multitudinous impressions continually besieging us from our whole sensory surface, we notice so very small a part. It would appear that no incoming current can be recorded in conscious experience until it succeeds in penetrating to the cerebral hemispheres and filling their pathways by the processes set up. So long as other currents possess the fortress, the incoming ones cannot succeed. When the occupiers of the citadel are starved out by the running short of Attention,

other currents may enter, and those will be admitted which are most in accord with the reigning ideas of the moment—*i.e.*, those which are said to "interest" us at the time. There is always, however, a liability to disintegration of the reigning system. The absorption is not complete, the excluded currents are not wholly abortive, but affect the fringe and margin of our thought.

Dispersed Attention. — Again, a reigning system may not be in active commission. There are occasions when the whole mental attitude is lax, the mind taking its ease, and no definite occupation of the cerebral hemispheres discernible. Any impulse sufficiently strong to stand out from the rest will then attract attention. Between this "dispersed" attention and the mental concentration so intense that bodily injuries are unfelt, are intermediate degrees, which have been studied experimentally, in attempts to answer the question: "What is the Span of Consciousness?" How many objects can we attend to at once when they are not embraced in one reigning system? "Professor Cattell experimented with combinations of letters exposed to the eye for so short a fraction of a second that attention to them in succession seemed to be ruled out. When the letters formed familiar words, three times as many of them could be named as when their combination was meaningless. If the words formed a

sentence, twice as many could be caught as when they had no connection. . . ."

When the data are so disconnected that we have no conception which unites them, it is much harder to apprehend several of them at once, and the mind tends to let go of one while it attends to another. Still, within limits this can be avoided. M. Paulhan has experimented on the matter by declaiming one poem aloud whilst he repeated a different one mentally, or by writing one sentence whilst speaking another, or by performing calculations on paper whilst reciting poetry. He found that the most favourable condition for the doubling of the mind was its simultaneous application to two *heterogeneous* operations. Two operations of the same sort, two multiplications, two recitations, or the reciting of one poem and writing of another, render the process more uncertain and difficult.

M. Paulhan compared the time occupied by the same two operations done simultaneously or in succession, and found that there was often a considerable gain of time from doing them simultaneously. For instance: "I multiply 421, 312, 212, by 2; the operation takes six seconds; the recitation of four verses also takes six seconds. But the two operations done at once only take six seconds, so there is no loss of time from combining them."

It appears, then, that the number of entirely disconnected processes that can go on simultane-

ously is hardly more than one, unless the processes are very habitual, but then two or three without very much oscillation of the attention. The less automatic, the more *intellectually* exacting the processes are, the greater is the tendency to an *oscillation* of the mind from one to the other, instead of simultaneous attention.

Where minute sensations are to be attended to—*e.g.*, dots on a piece of paper—Wundt found that the number the mind could attend to at once is at most six. With more complex objects, three to five can be apperceived* at once, but probably only one object can be in the absolute focus of attention.

The effects of attention may be briefly stated as follows:

1. It arrests the general tendency to change in the contents of consciousness, not, of course, absolutely, but by securing a relative fixation of the derived idea about which the mind plays, oscillating about it as a central point, considering it now in one aspect, now in the other, until attention to that idea is exhausted.

2. Attention to a sensation or simple percept *intensifies* it. Thus, hurts unheeded in the excite-

* *Apperception* = the entry of a presentation into the full focus of attention, so that it is perceived with maximum clearness.—WUNDT.

Focus of attention = the portion of the psychosis in which we find the most intense degree of consciousness.

ment of a game are felt to be painful when a pause or the sight of blood calls attention to them. With the increase in intensity goes increased *definiteness*, perhaps as a result of the former. Thus a chord in music attended to seems louder than the rest.

This greater definiteness and intensity are due partly to the fact that in attending the sense-organs are adjusted to receive the impression. They are placed in the best position, and may even be partially excited by the conscious effort to attend.

3. Attention tends to *limit* the *area* of consciousness. The more we attend to certain presentations, the less can we attend to other and competing presentations. We narrow the field in order to secure clearer and stronger impressions from the smaller quantum attended to.

4. Attention gives a greater probability of reproduction. We all know that we are most likely to recall what we have attended to most. Partly, perhaps, this is physiological, the greater amount of attention corresponding to a greater modification of the nerve track. Partly, attention to a presentation tends to link it up to a greater number of other ideas and presentations than would have been the case had attention been fainter. There is therefore greater possibility of revival by association; the presentation or idea attended to becomes more completely a part of our mental system.

5. Attention produces a *shortening of the reaction time*,* due, doubtless, to pre-adjustment of the sense-organs, which being put on the *qui vive* by attention, respond more rapidly to the anticipated stimulus. They are in a state of greater sensibility than would otherwise be the case. Wundt found, as a result of a series of experiments, that with preadjustment reaction time occupied on the average 0·076 of a second, as compared with 0·253 of a second where no warning had been given. With practice, the reaction time diminished so much that the reaction takes place absolutely at the same time as the anticipated stimulus. But the reaction time is lengthened if any conditions are introduced to render attention difficult—*e.g.*, weakening the stimulus.

Sensation of Strain.—Everyone has noted that in cases of intense attention there is a sensation of strain. This is felt, in the case of external perception, in the sense-organ itself—*e.g.*, the tension experienced in eye or ear in attempting to catch a distant sight or sound. In the case of attention to thought or memory the tension is felt to be in the head itself.

Wundt showed that motor innervation occurs not only in actual movement, but also in attention.

* *Reaction time* = interval between reception of a stimulus and a muscular reaction thereto—*e.g.*, kicking a football after the referee's whistle has been heard.

Thus in attending, the muscles have a tendency to contract, hence the sensation of strain. The association of perception and motor reaction is such that, even where actual muscular movement does not ensue, muscular innervation is felt in the sense-organ which receives the sensory stimulation. Even where there is no external stimulus, but only imagined sensation, we still get a stimulus sufficient to produce innervation of the muscles of the organs of sense. Thus, when we picture an object clearly in the mind, the eyes often become set, as if we really beheld the object. (See later, p. 151).

Varieties of Attention.—There are various divisions of attention. Objectively, it is either to—

(*a*) Objects of sense (sensorial attention) ; or to

(*b*) Ideal, or represented objects (intellectual attention).

It is either—

(*c*) *Immediate* (when the topic or stimulus is interesting in itself, without relation to anything else), or

(*d*) *Derived*, when it owes its interest to association with some other immediately interesting thing.

Further, attention may be either—

(*e*) Passive, reflex, involuntary, automatic, effortless ; or

(*f*) Active and voluntary.

Both (*e*) and (*f*) may be either sensorial or intellectual. In (*e*) the mind is conscious of no effort of will; the attention is given without any experience of choice among competing interests. In childhood and youth there is great tendency to involuntary immediate attention to sensorial stimuli. As the years pass this alters—we have chosen our interests, organized our minds, and attention is less likely to stray outside "the daily round." But in youth, with great elasticity and energy of mind, there is little organized interest to furnish restricted objects for attention, and the attention goes straying among the various objects presented. Everyone who has tried, knows how difficult it is to keep the attention of a class of children to the work in hand. Stories, pictures, interruptions, they are interested in at once; but steady, serious work is almost impossible. Hence the necessity, in lessons, of artificial interest — prizes, rewards, etc. — to stimulate attention.

There is also a passive *derived* attention, the stimulus being relatively small, but the effect produced deriving its coerciveness from mental habits or systems built up in life. "How a bit of bad grammar wounds the ear of the purist! How a false note hurts the musician, or an offence against good manners the man of the world" (Herbart).

In *voluntary* attention, which is most important for the mental development of man, there is a conscious effort to attend, a concentration of the mind on some object or presentation, with a deliberate exclusion of others from the sphere of attention. This desire to attend draws its power from previous reflection and resolution, which have indicated the objects attention to which is necessary for the well-being of the individual as a whole.

Exertion of will is necessary, but, says James, "there is no such thing as voluntary attention sustained for more than a few seconds at a time. What is called sustained voluntary attention is a repetition of successive efforts which bring back the topic to the mind. The topic once brought back, if a congenial one, develops; and if its development is interesting, it engages the attention passively for a time." It is only in disease that one fixed and unvaried idea (*idée fixe*) possesses the mind. "If we wish to keep (the mind) upon one and the same object, we must seek constantly to find out something new about the latter, especially if other powerful impressions are attracting us away" (Helmholtz).

Conditions of Attention.—There are certain conditions of attention which may be briefly stated as summing up to some extent what has been said above.

Objectively, the general conditions are—

1. *Intensity.*—The greater the stimulus, the greater the attention.

2. *Duration.*—The longer an object is presented, the more attention it will get, subject to its not being presented so long as to exhaust interest.

3. *Repetition* may take the place of duration.

4. *Novelty.*—The novelty, must not, however, be so great as to lift the object out of connection with the objects which interest us generally.

5. *Absence of Rivalry.*—This is a consequence of the principle of Limitation already dealt with.

Subjectively, the conditions are—

1. *The Amount of Disposable Consciousness.*—Little attention can be got from schoolboys sleepy after lunch.

2. *Special Interest.*—Where great pleasure or pain is attached to presentations, attention is coerced.

3. *Preadjustment*, which has been dealt with already.

Retentiveness.—Mental activity, however varied and constant, would be comparatively valueless without some form of retentiveness. If the results of experience are not retained to modify future experiences, and to form a starting-point for further additions to knowledge, all progress and development are impossible. Psychologically, these effects of past impressions are

known as traces or dispositions, left in the matter of nerve fibres and neural processes to determine the nature and course of subsequent process. These dispositions are not absolutely persistent; they tend to decay if not renewed or reinforced by renewal of the mental process or its associated processes. Individuals vary in the matter, some, as Locke said, retaining the characters drawn on them like marble, others like freestone, and others little better than sand. The explanation of these differences, so far as they are a matter of original endowment and not of training, is doubtless physiological.

In conative process, the continuous striving towards a definite end, retentiveness is always postulated; for in such a continuous process the persistence of each step after it is taken is indispensable. "Suppose that in the course of a few minutes we take half a dozen glances at a strange and curious flower. We have not as many complex presentations which we might symbolize as F_1, F_2, F_3; but rather, at first, only the general outline is noted, next the disposition of petals, stamen, etc., then the attachment of the anthers, form of the ovary, and so on. . . . It is because the earlier apprehensions persist that the later are an advance upon them and an addition to them" (Ward).

In all reproduction and association persistence

of prior presentations is fundamental, and it is this retentiveness which makes possible the modification of existing impressions by those preceding, which we have drawn attention to under the Law of Relativity. In listening to music, the pleasure derived from harmonic chords is possible because we retain the impression of preceding notes while hearing the later notes sounded, and so secure the effect as a whole, instead of as a series of disconnected sounds suddenly emerging in consciousness. The pleasure derived from reading poetry is due largely to the fact that the rhythm and qualities of preceding words and lines are present when later words are read.

The fact of retentiveness is illustrated clearly by pathological cases. In moments of delirium, the patient rambles on in incoherent sentences, often giving expression to facts which, in normal moments, would not be remembered. This indicates that the physiological dispositions connected with earlier presentations of such facts exist, and when stimulated by pathological conditions (changes in blood-pressure, etc.), produce their usual reactions. Again, under hypnotic suggestion patients have remembered occurrences they were unable to recall in ordinary circumstances, showing that the necessary traces existed, but so faintly or so overlaid by alien spheres of interest that nominally they were

inhibited by the subject, and could only exert influence when the controlling mind was set aside under hypnotism.

Since all knowledge, at all events for use, is a knowledge of cause and effect—of the relations between things not always present to sense—retentivity is a *conditio sine qua non* of mental development.

It is to be noticed that these traces or dispositions, in modifying existing presentations, do not usually or necessarily reproduce the exact impressions of which they are the legacy (*vide* remarks on Associationism). It is not that traces of *a*, *b*, and *c* are revived to modify *d*, producing a presentation equivalent to *a*, *b*, *c*, *d*. What is reproduced is the general effect or result of these previous impressions, their effect on the mind of the subject, their relation to his mental life as a whole. The word which sums this up is *meaning* or *significance*. Thus, what is reproduced is the *meaning* to the subject of the previous impressions *a*, *b*, *c*. This meaning is enlarged or modified in presence of the further impression *d*, and until further data are supplied this last modification persists as the meaning or significance in the life of the subject of the kind of object of which *a*, *b*, *c*, *d* are presentations.

Association and Reproduction.—We have used the word reproduction. This, with associa-

tion, plays a great part in psychical life. Having once seen an apple, and heard it so called, a later repetition of the name may call to my mind a mental picture of the apple, although the fruit is not actually present; similarly, a repetition of the object may recall to my mind the name given it—apple—and I name it accordingly. This is due to the fact that the presentation of apple and the hearing of the name having occurred together as part of the same conscious process, when one recurs it tends to excite the disposition left behind by the other, and this may proceed in such a way as to call up a mental picture of the apple, or lead to the pronunciation of the name. The *possibility* of such a reproduction is due to *retentiveness*, the traces left by previous experience. In each case of *actual* reproduction, association probably supplies the immediate cause. The disposition left behind by the previous experience must be re-excited if the experience itself is to be reproduced, and this re-excitement is usually due to some presentation similar to one which has formed a part of the total psychosis with the experience which is to be reproduced. Thus the reproduction is due to previous association of the reproduced and the reproducing presentation.

Acquirement of Meaning.—Reproduction has many degrees and modes, according as the prior presentation is reproduced more or less com-

pletely. The *least* that can happen to justify the word reproduction at all, and the minimum necessary for the development of mental life, is what we have referred to above as the acquirement of "*meaning*" or "significance." Thus in the connected series of presentations *a*, *b*, *c*, *d*, *d* has, originally, a meaning due to the disposition left behind by *a*, *b* and *c*. Let us call this *d* M. Now, if the series is reinstated, let us say by the sensation *a* recurring, the starting-point of the series as reproduced is no longer *a*, but *d*M. That is, *a* has *acquired meaning* (*d*M) through previous experience. Thus, the first time one hears such a familiar song as "There is a happy land, etc.," each word and line and note has a meaning derived from its connection with the whole (see above—"retentiveness"). Now, when the song is well known, the mere hearing of the first few words or notes is sufficient to enable one to recognize the song. There is no need for the whole process to be repeated. The first words or notes stand for or *mean* the rest, and it is unnecessary, therefore, to repeat the whole.

"Let us now take a case which belongs to quite a low level of conscious life. A chick on emerging from the cell, and without previous experience, tends to peck at, seize, and swallow all small objects. This is a conative process, which has for its end the cessation of the appetite for food.

Now, the chick does not, at first, distinguish between what is edible and what is not. This it has to learn by experience. It will at the outset peck at and seize all worms and caterpillars indiscriminately. There is a particular kind of caterpillar called the cinnabar caterpillar. When this is first presented to the chick it is pecked at and seized like other similar objects. But as soon as it is fairly seized it is dropped in disgust. When next the chicken sees the caterpillar it looks at it suspiciously, and refrains from pecking. Now, what has happened in this case? The sight of the cinnabar caterpillar re-excites the total disposition left behind by the previous experience of pecking at it, seizing it, and ejecting it in disgust. Thus the effect of these experiences is revived. The *sight* of the cinnabar caterpillar has acquired a *meaning*. It means the experience which, in the first instance, followed it; and just because it means them, it may more or less dispense with the necessity of actually repeating them. It may so determine the course of action that repetition or reinstatement of the specific items of the previous experience is needless. To this extent it is practically equivalent to them: it functions instead of them" (Stout: "Manual of Psychology").

This re-excitement of the disposition left behind by previous experiences, not merely as they

occurred, but as modified in the course of the previous process, means that the process will not again take place as it did before. The meaning acquired in the previous experience and now revived by the sight of the cinnabar caterpillar prevents this. For the end of the conative process, of which the sensation of sight, pecking, etc., were the parts, is the satisfaction of the desire for food, the cessation of hunger. Now the chick, to reach this end, tries various methods, one of which was the taking of the cinnabar caterpillar. So far as a method is *successful*, it will tend to be repeated. So far as unsuccessful, it will tend not to be repeated—*i.e.*, to be varied. The *meaning* the earliest attempts acquire (what we call roughly "learning by experience") determines whether they shall be repeated or not. The taking of the cinnabar caterpillar having been found useless for the end desired, this "significance" is revived by the sight of such a caterpillar, and the full process of pecking, seizing, tasting, and ejecting does not again occur. The meaning acquired in previous experience renders unnecessary the repetition of the whole process. And this is characteristic of all conative process. Successful adjustments of muscles or ideas tend to persist, unsuccessful ones are eliminated. It is merely another example of evolutionary process (adjustment to environment), and is due to repro-

duction, or acquirement of meaning. As indicated above, the opportunity for reproduction is furnished by an existing presentation which has been in past experience associated with some part of the reproduced process.

LAWS OF ASSOCIATION have occupied in many English psychological writers a very important place (*e.g.*, Mill, Bain, and Spencer). Mill held them to be as important in Psychology as the law of gravitation in astronomy. The modern tendency is rather to depose them from this supreme position, and to treat them on the lines of Aristotle and Locke, as special *laws of memory.*

We may distinguish between—(1) the revival of connected impressions in PERCEPTION; and (2) the revival of connected images and concepts in memory, reverie, thought, and other similar ideational process.

"Complication" is the name proposed by Dr. Ward for (1), "association" being restricted to (2). Thus, we may note the manner in which the sight of a suit of armour revives connected impressions of hardness, coldness, smoothness (*sensational* elements), as compared with the way in which it calls up ideas of tournaments, crusades, chivalry, etc. Association, properly so-called, has place, in this view, only between percepts already *generalized* or ideas; or, as

Dr. Bradley says, "Association marries only *universals*"—*systems of thought*, not accidents of sensational contiguity.

The Laws, as usually stated are, in brief—

Law of Contiguity.—Presentations which have occurred together or in close proximity tend to cohere in such a way that when any of them is afterwards presented to the mind, the others are apt to be brought up.

Law of Similarity.—Like presentations tend to recall their like among previous experiences.

Law of Compound Association.—Past presentations are recalled more easily when associated either through contiguity or similarity with more than one present object or impression.

Law of Contrast.—Things, thoughts, contrasted with each other, are mutually suggestive (Hamilton).

The Law of Contiguity is the really important one, the other laws being rather derived ultimately from contiguity than ultimate in themselves. But the matter will be dealt with more fully under "Thought."

CHAPTER VII

SENSATION

SENSATIONS are due in all cases to stimulation of the organs (generally external) of the body. The pain, the shower of sparks, experienced after a blow on the eye, are sensations due to the stimulus (the blow) applied to the sense-organ (the eye) at its outer surface, or periphery. The sensation of *red* is due to the stimulation of the eye by ether-vibrations of a certain wave length. Sound is due to the stimulation of the drum of the ear by waves of air of varying lengths. These stimulations are conveyed, as already stated, by nerve fibres to the brain, and there give rise to changes in the brain matter, which result in the experience of sensations.

Sensations are the data of mental life, "first things in the way of consciousness" (James). It is in mental processes set up by them and using them as material that the complex operations of the mind consist. Sensations fulfil, therefore, a *cognitive* function—*i.e.*, they are the

means by which we cognize or learn the character of the world surrounding us.

As already indicated, such a thing as *mere* sensation can be realized, if at all, only in the earliest days of life. Every sensation, psychologists have come to think, leaves upon the brain-matter some trace, some modification, not necessarily conscious, so that never again can that sensation occur without being affected by its predecessors. Consider, then, *all* the sensations to which the human mind is subject from the hour of its birth, and it will be clear how infinite are the modifications of the convolutions of the brain, how varied the interactions and associations of every sensation received. Hence something much more complex than *mere* sensation. "Ideas," memories, of the object furnishing the stimulus mingle with the sensation it arouses, and the mind names, classifies, compares, makes statements as to the attributes of it; and this complex content of consciousness, which may be aroused by an incoming sensation, goes on increasing to the end of life. Generally, PERCEPTION is the name given to this cognitive development of sensation, in which the simple stimulation of sense-organs gives rise to mental processes by which we recognize our friends, avoid our enemies, note the beauties of nature, and classify its wonders. The distinction between sensation and perception is

not very sharp, for, as ordinarily understood, sensation is a percept of a relatively simple kind. It differs from perception only in the extreme simplicity of its object or content. Sensation knows the *fact*—the prick of a pin-point. Perception knows *about* the fact—the possibility of blood-poisoning, the nature of the wound, etc. "We must know *what* fact we mean" (*i.e.*, what facts we have perceptions of), "and the various *whats* are what sensations give" (James).

Sensation and perception have this in common —that their objects appear vivid, clear, striking. Objects which exist only as ideas in the mind—that is, objects remembered or imagined—have not this clear and distinct impressiveness. Objects presented in sensation and perception have a *coerciveness* which is in general denied to the products of the mind, unless under the influence of disease or hallucination.

It should be observed that all sensations are not necessarily present in consciousness. The writer of a book is, as he writes, the recipient of various sensations, which do not modify his train of thought. The heat of the fire, the light of the lamp, the ticking of the clock, the movements of the household, are not present to him as he writes. If he ceases work, and turns his attention to the environment, these sensations immediately assume a coercive character they

had not before. Certainly, if, while he was writing, the heat of the room decreased, his total experience would be different, and after a time the temperature would force itself upon his attention; but the fact remains that all sensations do not necessarily play an active part in the mental life of the recipient. (See also the chapter on "Subconsciousness.")

The question of the *exteriority*, or place-localization, of sensations has already been dealt with.

Classification of Sensations. — The usual classification is into Special and General—those possessing a definite and localized sense-organ, and those not so equipped. The special sensations are—Sight, Hearing, Taste, Smell, and Touch. The *general* sensations are the *organic* or *systemic* sensations, such as those of the stomach, viscera, etc. The special sensations are better fitted for discrimination and retention than the general; they are better localized, and more suited to afford knowledge of the external universe.

Another classification, that of Wundt, divides the senses into—(1) Those whose sensations have only one definite quality, subject to degrees of intensity (Touch, Organic, and Motor sensations); (2) those whose sensations have various types of quality, each of which is susceptible of different degrees of intensity (Sight, Hearing, Taste, and Smell).

Another division is into Mechanical (Touch, Hearing) and Chemical (Sight, Taste, Smell) senses.

Attributes of Sensations.—Sensations have certain attributes generally recognized by psychologists. These are Intensity, Duration, Quality. A fourth attribute, Extensity, seems to belong to certain sensations, especially those of Touch and Sight. Thus, if a finger-tip presses against a table, we have a sensation differing from that of the whole surface of the hand pressing against the table. It is not merely a case of more or less pressure, there is a feeling of *extension* of sensation, and this feeling is of essential importance in the development of the perception of space.

Other important aspects of sensation are Complexity, Relativity, Local Character, and Affective Tone.

Intensity.—A light may be so weak as not sensibly to dispel the darkness, a touch may be so slight as not to be felt, a smell so faint as not to be noticed. Thus a certain amount of stimulus is required to produce any sensation at all. This Fechner called "the law of the threshold"—something must be stepped over before the object can find entrance to the mind through sensation.

Weber's Law.—These facts have been the subject of considerable experiment, and as a result of his investigations Weber enunciated the

law known by his name, to the effect that the increase in stimulus necessary to produce an increase of sensation in any sense is not a fixed quantity, but depends upon the *proportion* which the increase bears to the immediately preceding stimulus. Or, as it is sometimes expressed, in order that the sensation may increase in *arithmetical* progression, the stimulus must increase in *geometrical* progression. Weber arrived at his conclusions by experimenting with weights, gradually adding to or decreasing a given weight in the hand, and so ascertaining at what points in the process of increase or decrease a *perception* of difference arose. Wundt's account of the law and of the facts on which it is based may be quoted, both for the importance of the law and as an interesting example of psychological investigation: "Everyone knows that in the stilly night we hear things unnoticed in the noise of day. The gentle ticking of the clock, the air circulating through the chimney, the creaking of the chairs in the room, and a thousand other slight noises, impress themselves upon our ear. It is equally well known that in the confused hubbub of the streets or the clamour of a railway we may lose not only what our neighbour says to us, but even not hear the sound of our own voice. The stars which are brightest at night are invisible by day, and although we see the moon then, she is far

paler than at night. Everyone who has had to deal with weights knows that if to a pound in the hand a second pound be added, the difference is immediately felt; whilst if it be added to a hundredweight, we are not aware of the difference at all. . . .

"The sound of the clock, the light of the stars, the pressure of the pound, these are all stimuli to our senses, and stimuli whose outward amount remains the same. What, then, do these experiences teach? Evidently nothing but this, that one and the same stimulus, according to the circumstances under which it operates, will be felt either more or less intensely, or not felt at all. Of what sort now is the alteration in the circumstances upon which this alteration in the feeling may depend? On considering the matter closely, we see that it is everywhere of one and the same kind. The ticking of the clock is a feeble stimulus for our auditory nerve, which we hear plainly when it is alone, but not when it is added to the strong stimulus of the carriage wheels and other noises of the day. The light of the stars is a stimulus to the eye. But if the stimulation which this light exerts is added to the strong stimulus of daylight, we feel nothing of it, although we feel it distinctly when it unites itself with the feebler stimulation of the twilight. The pound weight is a stimulus to our skin which

we feel when it joins itself to a preceding stimulus of equal strength, but which vanishes when it is combined with a stimulus a thousand times greater in amount.

"We may lay it down therefore as a general rule, that a stimulus in order to be felt may be so much the smaller if the already pre-existing stimulation of the organ is small, but must be so much the larger, the greater the pre-existing stimulation is. . . . The simplest relation would obviously be that the sensation should increase in identically the same ratio as the stimulus. . . . But if this simplest of all relations prevailed, . . . the light of the stars, *e.g.*, ought to make as great an addition to the daylight as it does to the darkness of the nocturnal sky, and this we know to be not the case. . . . So it is clear that the strength of the sensations does not increase in proportion to the amount of the stimuli, but more slowly. And now comes the question, In what proportion does the increase of the sensation grow less as the increase of the stimulus grows greater? To answer this question, every-day experiences do not suffice. We need exact measurements, both of the amounts of the various stimuli and of the intensity of the sensations themselves.

"How to execute these measurements, however, is something which daily experience sug-

gests. To measure the strength of sensations is, as we saw, impossible: we can only measure the *difference* of sensations. Experience showed us what very unequal differences of sensation might come from equal differences of outward stimulus. But all these experiences expressed themselves in one kind of fact, that the same difference of stimulus could in one case be felt, and in another case not felt at all—a pound felt if added to another pound, but not if added to a hundredweight. . . . We can quickest reach a result with our observations if we start with an arbitrary strength of stimulus, notice what sensation it gives us, and then see how *much we can increase the stimulus without making the sensations seem to change.* If we carry out such observation with stimuli of varying absolute amounts, we shall be forced to choose in an equally varying way the amounts of addition to the stimulus which are capable of giving us a just barely perceptible feeling of *more.* A light to be just perceptible in the twilight need not be near as bright as the starlight; it must be far brighter to be just perceived during the day. If now we institute such observations for all possible strength of the various stimuli, and note for each strength the amount of addition of the latter required to produce a barely perceptible alteration of sensation, we shall have a series of figures in

which is immediately expressed the law according to which the sensation alters when the stimulus is increased. . . ."

In the case of pressure "we find a surprisingly simple result. *The barely sensible addition to the original weight must stand exactly in the same proportion to it*, be the *same fraction* of it, no matter what the *absolute* value may be of the weights on which the experiment is made. . . . As the average of a number of experiments, this fraction is found to be about one-third; that is, no matter what pressure there may already be made upon the skin, an increase or a diminution of the pressure will be *felt*, as soon as the added or subtracted weight amounts to one-third of the weight originally there."

The ratio in the case of *light* is $\frac{1}{100}$.
The ratio in the case of muscular sensation is $\frac{1}{17}$.
Feeling of pressure, Feeling of warmth, Feeling of sound } is $\frac{1}{3}$.

(*Wundt*, quoted by James.)

Weber's law is only approximately verified, and must not be taken absolutely. With sensations of very high or low intensity it does not hold, and in other cases it is not certain. It is, what every natural law is, a statement of a general tendency, not necessarily true in every particular case.

EXTENSITY.—This has been dealt with above (p. 106).

QUALITY.—There are *general* differences of quality, due to separate sense-organs—*e.g.*, light is different from sound, etc. There are also *specific* differences of quality which obtain between different sensations of the same organ—*e.g.*, high and low pitch in sound, etc.

COMPLEXITY.—We have already referred to the fact that sensations, after a very early stage, are not *simple* or *mere* sensations. Similarly, few sensations are *pure* in the sense that they are due to one sort of stimulation only. Weight-holding gives us sensations of touch, pressure, coldness, smoothness, sight. Colour sensations are usually due to a mingling of different primary colours. Musical notes, to the musician, are full of overtones.

RELATIVITY. — This has already been dealt with (p. 69).

LOCAL CHARACTER.—This is probably a part or derivative of the sensation of *extensity*, and may more properly be discussed under the heading of *space perception.* The relation of any particular sensation to the whole sensation-continuum of extensity may be said to be its "local sign" (Lotze). Thus in a bath one has a massive sensation due to the general contact with water. The specific sensation coming from the hand as compared with the *general* sensation may be said to be the "*local sign*" of sensation in the hand.

Duration.—This need not be dwelt on here. It is a matter of Time Perception.

Affective Tone.—By this is meant the *emotional* character of the sensation—its *pleasurableness* or *painfulness*. This is not fixed, as Quality is. For in different circumstances the same sensation may give pain or pleasure; it has not always the same affective tone. Thus light, which to the tired eye is painful, in other circumstances is pleasant and stimulating. Sound, which is pleasant up to a certain intensity, may become painful when it increases beyond a certain volume. The weight of a knapsack cheerfully borne when commencing a walk may become intolerably burdensome after a few miles have been passed.

Organic Sensations.—Organic sensations are much vaguer than those of the special senses. They are not definitely localized nor discriminated (how often it is difficult to say *which* tooth aches), nor, of course, are they *projected* from the body. They are not easily revived. They usually indicate states of the organism itself, rather than afford evidence of external objects, and are of very great importance as regards *pleasure* and *pain*. They are the main factors in the general feeling of comfort or discomfort, health or disease, fitness or unfitness, which forms, at any time, the background of our psychical life.

Bain's classification of the Organic Sensations is—

1. Organic sensations of Muscles, Bones, etc.: cramp, fatigue, wounds.
2. Organic sensations of Nervous Tissue: neuralgia.
3. Feelings connected with Circulation and Nutrition: thirst, starvation.
4. Feelings of the Respiratory Organs: suffocation.
5. Feelings of Heat and Cold (better *not* regarded as organic sensations).
6. Organic sensations of the Alimentary Canal: relish, hunger.
7. Feelings connected with the Sexual Organs, Mammary and Lachrymal Glands, etc.

CHAPTER VIII

SPECIAL SENSATION

Before going on to the various special sensations of Sight, Sound, Touch, Taste, Smell, it would be well to consider the special sense-organs themselves. It seems clear that the highly differentiated sense-organs of man are not primordial, but derived. Some psychologists have assumed the existence of "absolute units of sensibility" all exactly the same, and they explain the variety in our sensations by alleging *different* integrations of these units in the different sensations. The evidence does not bear out this view, such evidence as is offered being entirely physiological.

Turning to Biology, we find reason to believe that the various highly-organized special sense-organs have developed gradually from a single cell—the unicellular organism. Protoplasm, "the physical basis of life," is amenable to every sort of stimulation save magnetism, and it is fair to assume that the one-celled organism, which is of protoplasm, is similarly amenable. Now, in such organisms there is no differentiation of

function morphologically—*i.e.*, there is not one part of the organism functioning in reaction to light, one part functioning in response to touch, and so on. The whole cell reacts as a whole, in more or less peculiar ways, to each sort of excitation. It may be assumed, therefore, that the whole cell acts as a sort of central or general sense-organ, and that, as the advance in structure and function from the single-celled amœba to the multicellular vertebrate has been gradual, so has been the advance from the single universal sense-organ to the highly-specialized sense-organs of man. "Numerous cases can now be adduced of the occurrence of 'transitional' or 'alternating' sense-organs among the lower forms of multicellular animals—organs, that is to say, which are normally responsive to two or more kinds of stimulus, and thus hold an intermediate position between the *universal* sense-organ of the *protozoa* and the *special* sense-organ of the *mammalia*. For example, a group of cells which would behave towards all stimuli impartially were they independent unicellular organisms, become, as an organ in a multicellular organism, amenable only to mechanical or only to chemical stimuli—become, that is to say, an organ of touch and of hearing, or an organ of taste and also of smell—until finally, when differentiation is sufficiently advanced, the group ends by becoming exclusively

the organ of one specified sense, touch or hearing in the one case, taste or smell in the other. Of course, the imperfectly specialized sensation, say, of the leech, and still more the wholly unspecialized sensations of the amœba, cannot be regarded as blends of some or all of those which we are said to receive through our five senses. We must rather suppose that sensations at the outset corresponded very closely with the general vital action of stimuli as distinct from their action on specially differentiated sensory apparatus" (Ward). Thus, in considering the wonderfully constructed sense-organs of the human being, we are to regard them as the highest point in a course of development by adjustment to constantly varying environment. With the increasing differentiation among the organs has gone an increasing complexity in the organ itself, and completer control by the central nervous system for the furtherance of the aims of the subject. As in society, so in the human organism, "an indefinite, incoherent homogeneity" has become a "definite, coherent heterogeneity" (Spencer).

Sight.

For a full description of the structure of the eye the student is referred to works on anatomy. We shall indicate here only the anatomical points useful to the psychologist.

The eye is a flattish sphere formed by a tough

white membrane (the sclerotic), which encloses a nervous surface (retina) and certain refracting media (lens and "humours"), which cast a picture of the outer world thereon. It is, in fact, an arrangement of lenses which bring the rays to a focus on a sensitive surface (the retina), just as a camera brings rays to a focus on the glass plate at the back. In front the outer coat becomes transparent (the cornea), and behind this lie the aqueous humour, the crystalline lens, and the vitreous humour. The crystalline lens (double convex) is capable of change of shape, becoming more convex by the action of the automatic ciliary muscle. The *iris* serves to cut off the marginal rays, and thus helps to secure a clear image. The eye is lined internally by the dark *choroid* membrane. The optic nerve pierces the sclerotic shell, and spreads its fibres in every direction over the inside, forming a thin translucent film. The fibres pass into a complicated apparatus of cells, granules, and branches, and finally end in the so-called rods and cones which are the specific

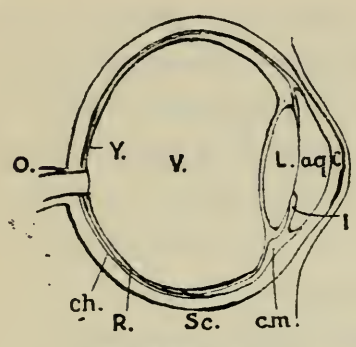


DIAGRAM OF EYE.

C, Cornea; *Sc*, sclerotic; *ch*, choroid; *L*, lens; *aq*, aqueous humour; *O*, optic nerve; *R*, retina; *I*, iris; *V*, vitreous body; *Y*, yellow spot; *cm*, ciliary muscle.

organs for taking up the influence of the waves of light. The rods and cones are not pointed forwards towards the light, but backwards towards the sclerotic membrane; so the light-waves *traverse the translucent nerve fibres* and the cellular and granular layers of the retina *before* they touch the rods and cones themselves.

The Blind Spot.—The nerve fibres themselves must thus be unimpressible by light *directly*. Where the optic nerve enters the sclerotic there is, in fact, a "blind spot," because nothing but

fibres exist there, the other layers of the retina only beginning round about the entrance. To prove the existence of this blind spot, close the right eye and look steadily with the left at the cross illustrated, holding the book vertically in front and moving it towards and away from the face. It will be found that at a certain distance —usually about a foot from the face—the disk disappears, but is visible when the book is held nearer and farther than this distance.

A luminous sensation may be excited by various modes of irritation of the retina or of the optic

nerve. Pressure, cutting, or electrical shocks may act as stimuli, but the usual excitation is the influence of light on the retina. This influence is due to the undulating movement of the particles of a generally diffused medium called the "luminiferous ether." This movement is a series of waves comparable to those which can be produced in a rope stretched from a fixed point to the hand. As the hand jerks the rope up and down, the wave movement travels along to the fixed end. The particles of the rope do not move along; the undulation only is communicated from one set of particles to another, and so traverses the whole rope. Similarly does the ether convey light-waves to the sensitive nerves. The *quality* of the light (yellow, green, red) is determined by the *length* of the waves; the *intensity* of the sensation is determined by the *amplitude* of the wave—*i.e.*, the distance between its crest and its trough—and on the *complexity* of the waves depends the degree of purity or saturation of the corresponding colour.

The Fovea.—Apart from the Blind Spot, the sensibility of the retina to light varies at different points. The point of greatest sensibility is the *fovea centralis*, a depression lying outwardly from the entrance of the optic nerve, where the only layer of the retina present is the cones. The sensibility of the retina grows progressively less

towards its periphery, where colours, shapes, nor number of impressions can be well discriminated.

Distinction must be made between (1) the purely *retinal* sensations, due to stimulation of the optic nerve, and (2) motor sensations connected very closely with (1), and due to the muscles controlling the eye, accommodating the organ to the object to be perceived. These play a great part in our visual perception of space.

In normal use of the two eyes, the eyeballs are rotated so as to bring the two images of the object attracting attention on to the two foveæ, thus getting the acutest vision. This is done involuntarily; indeed, it is almost impossible *not* to turn the eyes in this way when an object within the sphere of vision attracts attention.

Accommodation, or the mechanism of adjustment of the organ for different distances, is provided for in the case of the eye by muscles which increase or decrease the convexity of the eyeball, according as the object to be seen is nearer to or farther from us. This is different from the case of the camera, where this focussing or sharpening of the image is done by moving the lens or the sensitive plate backwards or forwards. From any point 65 metres or more distant from the eye the rays are practically parallel, and no accommodation is needed. Within this distance the eye

must be accommodated to secure a distinct image until a point is reached (usually 4·8 inches from the eye) which is the limit of clear vision for near objects. The accommodation between these two points is secured by the action of the ciliary muscle and of the circular ligament or capsule in which the crystalline lens is suspended. Ordinarily, this ligament holds the lens slightly flattened, but when near objects are contemplated, the ciliary muscle contracts, and so causes the ligament to relax. The lens then, owing to its elasticity, assumes a more convex form. Thus the accommodation for *near* vision is the more active change, as is well known from the fact that when feeling tired or having a sensation of strain in the eyes to rest them on distant objects affords relief.

Convergence of the two eyes accompanies accommodation to near objects, for to bring the images of such an object on the foveæ both eyes must turn inward.

Further, the iris adjusts itself to the amount of light during accommodation, opening more when light is dim to enable more to reach the retina, contracting when light is strong to prevent the sensitive nerve fibres being injured or dazzled.

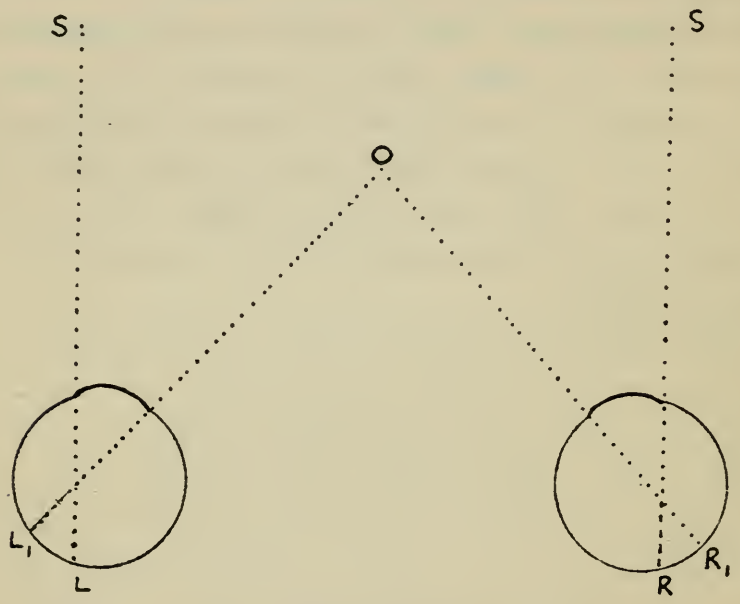
Single Vision.—Just as we hear single with two ears, and smell single with two nostrils, so we see single with two eyes. There is, however,

this difference, that we *can* see double in certain conditions, but in no circumstances can we smell or hear double.

The fact that we see single with two eyes is, briefly, due to identical points in the two retinas, anatomically connected, such that if the two images of an object fall on "identical points" on the two retinas they appear single. Thus, a pair of spectacles held an inch or so from the eyes seem like one large glass lying between them. The points are not identical in the morphological sense, but *corresponding parts*, established by experience. We have learnt that when two similar images fall on these, they are caused by a *single* object.

Erect Vision.—In a similar way, although the images on the retina are reversed, we *see* the object in its proper position—"right way up." "Up" and "down" are perceptions due to muscular sensations—one is movement against gravitation, and the other movement in the same direction as that in which bodies fall. In practical life we are not concerned with—indeed, are not aware of—the image on the retina, which is interesting as a physiological fact, but with the *significance* of the image as indicating a certain object. The sight-percept is in close connection with tactual and motor sensations, and interprets the image in accordance with them.

Double Images.—Double images are in certain conditions perceived, and it seems clear that just as images falling on *corresponding* parts of the retinas appear as one, so images falling on *disparate* parts of the retinas appear as two. Thus, in the diagram, the two eyes are converged upon an object *O* (near), and the foveæ therefore receive



the images of *O*, which thus appears single. Upon the eyes fall also the parallel rays of light from the star *S*. These rays, *SL* and *SR*, fall upon the nasal half of the retina which each strikes. But these nasal halves are *disparate*, not *corresponding*. Therefore the star's image on the left eye will appear as if lying to the left of *O*, and its image

on the right eye as if lying to the right of *O*. The star will then be seen double.

Similarly, if the *star* be looked at with parallel axes, any near object, like *O*, will be seen double, because its images will affect the outer or cheek halves of the eyes, instead of one cheek half and one nasal half.

It is remarkable that we do not notice more than we do the numerous double images constantly being produced by objects nearer and farther than the point of attention. We have, of course, trained ourselves to disregard, not to attend to, these.

Vision of Solidity, or the Third Dimension—Space Perception.—The appearance of solidity and distance is due to the same causes as single and double vision, combined with tactual experiences. Bishop Berkeley advanced a theory that perception of distance was not possible for the eye alone—that such perception is due to association between visual and tactual experience. This is confuted by the fact that we all *have* a perception of solid figure and distance which is essentially visual. But it is true that tactual and visual perception develop together. The great practical interest of sight depends mainly on its use in guiding active touch and the manipulation of objects.

The visual side of the perception of solidity or

distance depends upon the theory of *corresponding* and disparate areas of the two retinas. A double image is produced, as we have seen, by an object lying nearer to or farther away from the object in the focus of attention.

This double image, or rather, the effort of will by which the double image is ignored and the single image of the central object seen alone, gives to the mind an experience of nearness or distance in space. Our life experience (movement, touch, etc.) has taught us that where double images exist (apart from illness or other pathological causes) there is difference of distance among the objects seen, and therefore from the possibility of double images arises the perception of distance or solidity —the third dimension. The disparateness of the impressions on the retina yields either a double image or a perception of distance.

There is, however, another important factor in the visual perception of solidity, namely, the active exploration of the object by the eyes moving from point to point in it. This yields motor sensations due to the muscular movements by which the eyes accommodate themselves to the points attended to. Thus, when the eyes are fixed upon any part of the field of vision, those parts of the field which are behind or before this point are perceived by disparate impressions on the retina. So far as these disparate im-

pressions do not give rise to double images, they bring about a peculiar modification of visual sensation, varying with the disparateness of the impressions, which, again, varies with the distances of the objects from the point of attention. Now, active sight, the increasing or decreasing convergence of the two eyes, explores this data given to passive sight, and the intensity of the motor sensations produced in this exploration gives the perception of relative distance of the various objects from the point on which the eyes are fixed, while the movement of the two eyes becomes for consciousness movement over a tract of space.

Perception of the distance from the eye of the point on which the eyes are fixed is arrived at in much the same way. Whatever tends to fix the relative position of the various objects in the field of vision to the point of attention determines also the position of this point relatively to the other objects. So all objects intervening between the eye and the point attended to contribute to fix the absolute distance of this point. Then motor sensations doubtless come into play. The greater the sensation of convergence of the eyes, the nearer the point is, and so on. These movements of the eyes are, it must remembered, accompanied by optical sensations, displacement of impressions on the retinas, and Professor Hering has urged that these optical experiences are more important

than the motor sensations for experience of movement and position of the eyes.

Perception of Size.—Primarily, conclusions as to *size* are based upon the dimensions of the retinal image, after forming a judgment as to distance. This is largely a matter of experience. In the absence of some object of known size (*e.g.*, a man) for purpose of comparison, estimates of the size of strange objects are often very inaccurate.

Sensations of Colour.—Colour is a special sensation excited by the action on the retina of rays of light of a definite wave-length. Colour depends on the rate of vibration of the luminiferous ether, and white light is a compound of all the colours in a definite proportion. When an object reflects solar light without disturbing this proportion, the object is seen as *white*. When it absorbs all the light, reflecting nothing, then it is seen as *black*. If the object reflects some rays and absorbs others, it is seen as *coloured*, the colour being that caused by the ray or rays *reflected*.

The spectrum (the series of colours seen when a ray of sunlight is passed through a transparent prism, and emerges split up into its component simple lights projected on to a screen) shows red, orange, yellow, green, blue, and violet, merging insensibly into one another. Red, at

one end of the scale, is produced by waves of the greatest length (*i.e.*, slowest vibration), which impinge on the retina at the rate of 392 billions of impulses per second. At the other end, the vibrations producing the effect of *violet* are at the rate of 757 billions of impulses per second, according to the physicist. Vibrations below the number required to produce a sensation of red produce a sensation of heat; vibrations too rapid to produce a sensation of violet produce chemical activity. The Röntgen radiations are far above the violet.

Colours are best studied in the order in which they occur in the spectrum, care being taken to cancel the differences of saturation and brightness. This may be done by taking pieces of transparent coloured paper and modifying the brightness and saturation by placing beneath them pieces of grey or white paper.

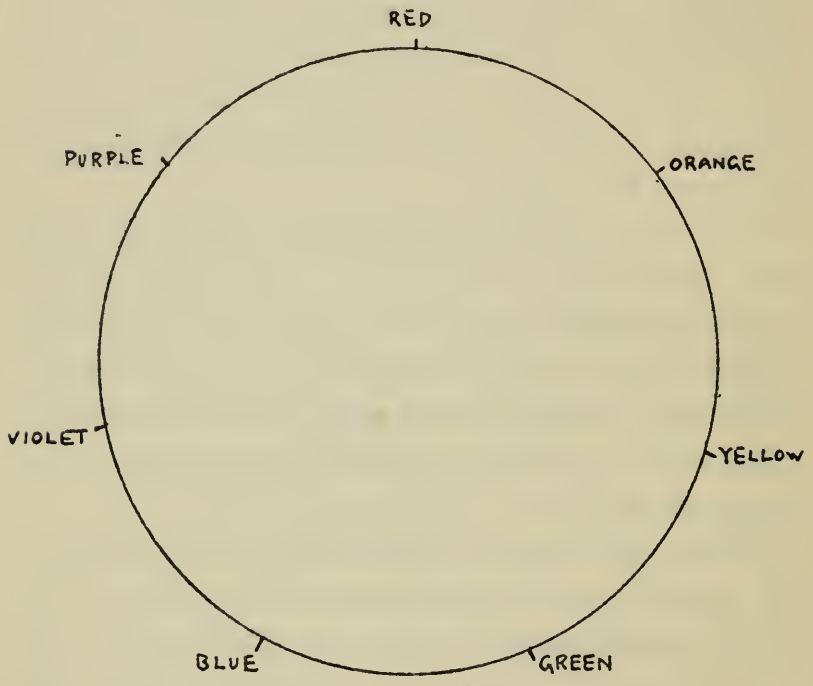
It is to be observed that taking any colour in the spectrum, say violet, one may pass in one direction through a series of violet more and more red to red itself, and in the other through violet more and more blue to blue itself.

The colours grade into each other in either direction, and are best represented in a circle, which indicates that in either direction we return to the colour from which we started, having

passed through modifications yielding the other colours *en route*.

Black does not appear in this diagram, but is not the less a colour.

By combining colours in different parts of the spectrum, the intermediate colours can be formed,



but red and violet, the highest and lowest, cannot be so produced. If to these two colours, green, the rate of vibration for which is about half-way between red and violet, be added, we get white. These three, therefore, have usually been considered FUNDAMENTAL COLOURS, and have

played a great part in theories of colour perception.

Complementary Colours.—It is found that certain pairs of colours affecting the retina together produce the sensation of white. Such colours are called "complementary" colours, and are spectral red and green-blue, spectral yellow and indigo-blue, green and purple.

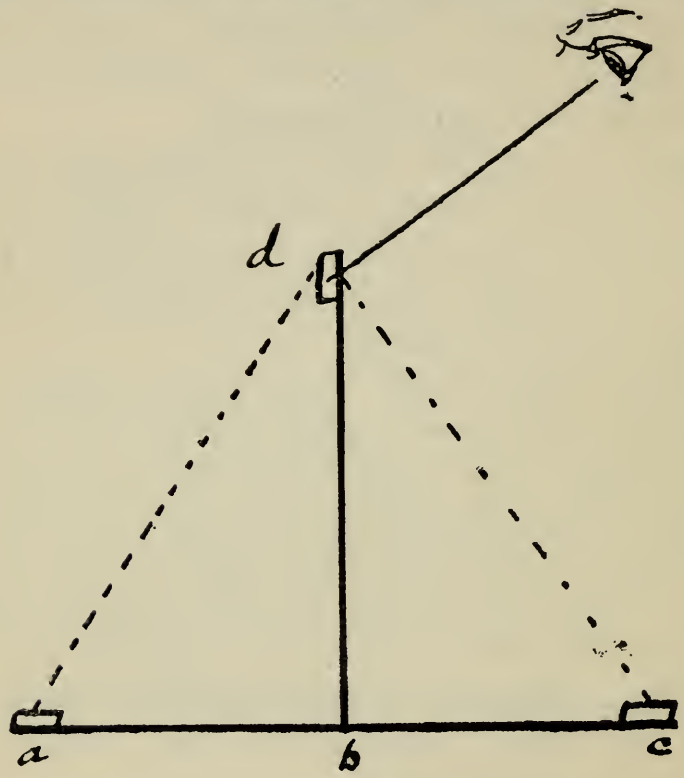
Again, we get the effect of *simple* colour from the mixture of waves of different colours—thus green and red give yellow, violet and green give blue, and purple results from either red and violet or blue and orange.

These effects may be readily studied by Lambert's method—*i.e.*, place a green wafer on *a* in the figure on p. 132 and a red wafer on *c*, then place a small glass plate at *d* in such a way as to transmit the reflections from *a* and *c* in the same line. A sensation of yellow will be experienced.

Another method is that of a revolving disk of cardboard, on which coloured sectors are painted. J. Clerk-Maxwell carried out this method by means of "colour-tops."

Even in the absence of external stimulation, complete darkness does not result. Specks or films are seen upon a sort of greyish ground. This is due to the eyes' own light (*eigenlicht*), which comes from stimulation of the optic nerve and brain-centres by alteration of blood-pressure or other systemic conditions.

Colour-Blindness.—Near the fovea the power of distinguishing colours is greatest, and here more than two hundred tints of colour can be distinguished. Beyond this area is a zone where fewer tints, mostly shades of yellow and blue,



are perceived. In faint illumination the greater part of the retina is colour-blind, and the extreme margin of the periphery is generally considered totally colour-blind. When the light is dim enough, all the spectral-colours pass into grey, and this "twilight vision" appears to be the

condition of the few persons who have been totally colour-blind, showing insensibility to colour-stimulus under all conditions. Everything is seen as black, white, or grey. For the most part, such persons cannot stand ordinary illumination, but are dazzled, and can only see clearly in dim light, which indicates functional defectiveness of the organ.

Partial Colour-Blindness.—This is fairly common, and usually consists of inability to distinguish between *red* and *green*. This may be due either to insensibility to red sensations, *or* to green sensations, or to both. The question has been much disputed, and it seems clear that there are two kinds of colour-blindness, one of which, it is said, consists of insensibility to *red* vibrations, and the other of insensibility to *green* sensations.

Colour-blindness is much less common in women than in men, is congenital, and incurable.

The Contrast of Colours.—This is a special case of the law of Relativity of Sensations. A small white, grey, or black object on a coloured ground appears to be tinted with the colour complementary to that of the ground. Thus, if the ground be red, the object appears green. Various physiological theories have been advanced to account for this phenomenon. The easiest way to study it is to place a small piece

of paper on a large, differently coloured piece and cover both with white tissue-paper. The covering obliterates contours and differences of texture in the two lower papers and enables the effect of contrast to be observed clearly.

After-Image.—A little introspection teaches us that luminous sensations last longer than the stimulus. If a match which is glowing red is rapidly whirled in a circular direction, although the eye receives a series of sensations from different points in the movement, the effect is that of a *complete* circle of light. The sensation produced at a point A in the movement lasts after the stimulus has passed on to a point B, and this after-image of the light at point A combines with later images to appear one continuous sensation. Similarly, meteors appear to have a luminous tail behind them. If we whirl a disk marked with alternate sectors of black and white, sufficiently quickly, we get, not alternate sensations of *black and white*, but a uniform sensation of *grey*, the sensation from one sector persisting and mingling with the sensation from the next. This kind of persistence gives the *positive after-image*. A common example is the image of the window with its panes and sections seen on closing the eyes immediately after looking at the window. To the continuance of retinal impressions the cinematograph owes its effect.

The Negative After-Image is more perplexing, and is probably due to exhaustion of the part of the retina previously stimulated. Continued staring at a black patch fatigues the portion of the retina receiving the sensation, and makes it no more, or perhaps less, sensitive to sensation than other portions. If, then, the gaze is shifted to a white wall, we see the wall as greyish with a white patch in it. The sensation yielded is weak because of the fatigue of the retina, and hence we get the impression of a white instead of a black patch. Similarly, a red patch gives a greenish-blue negative image. Thus the continuation of the same kind of stimulation tends to produce a contrast effect both in the part of the retina directly excited and the adjacent parts. This, when the original stimulation is withdrawn or reduced, produces a negative image. An exposure to light of about one-third of a second will give a *positive* image; much longer exposure tends to give a negative image.

Theories of Colour Sensation.—These are physiological and very complicated, in view of the little that is really known about the physical processes involved. The two theories which hold the field now are those of Helmholtz and Hering, and they may be briefly indicated for the information of the student.

Helmholtz assumed three ultimate physio-

logical processes corresponding to the sensations of red, blue, and green. By combining these colours in various ways, all the colours of the spectrum are obtained, while combined in equal proportion they yield *white*. The theory appears untenable, since in certain cases of colour-blindness it has been found while the sensation of *white* is experienced, the patient is unable to see green. Now, white is said on this theory to be a compound of green with red and blue. This is impossible in the case quoted, because the sensation of green is wanting. Helmholtz's theory does not, therefore, cover the facts.

Hering attempted to escape these difficulties by assuming *six* ultimate processes—red, green blue, yellow, black, and white, arranged in pairs, white and black, yellow and blue, red and green, to each pair a separate retinal substance and central modifications corresponding. He also assumed that chemical changes take place in the retina under the influence of light. His theory, which is very complicated, escapes the more obvious difficulties of Helmholtz's, and accounts for the formation of coloured after-images, but has difficulties of its own especially in reference to the sensation of *black*.

For further information on this question, the student should consult books on Physiology.

CHAPTER IX

HEARING

THE ORGAN.—This, a very complex organ, will be found fully described in physiological text-books. Roughly, it consists of three parts—an outer, a middle, and an inner ear. With the external ear we are little concerned. It does not appear essential for hearing, and its precise function is unknown.

The Middle Ear, or tympanum, consists of a small cavity in the temporal bone of the skull, into the inner side of which opens the Eustachian tube, running forwards and downwards into the naso-pharynx, and admitting air to the tympanum. The outer wall of the latter is formed chiefly by the tympanic membrane, separating entirely the middle from the external ear. This membrane is lined externally by skin, internally by mucous membrane continuous through the Eustachian tube with the mucous membrane of the naso-pharynx. Between the external skin and the internal mucous membrane is a firm fibrous membrane, convex towards its centre (inwards)

to form the umbo. The cavity of the tympanum is spanned by three small bones, *malleus*, *incus*, and *stapes*, connecting it with the membrane covering the *fenestra ovalis*.

The inner ear, or labyrinth, consists of a membranous and a bony part, the former being contained in the latter. The bony labyrinth is composed of the vestibule, the semicircular

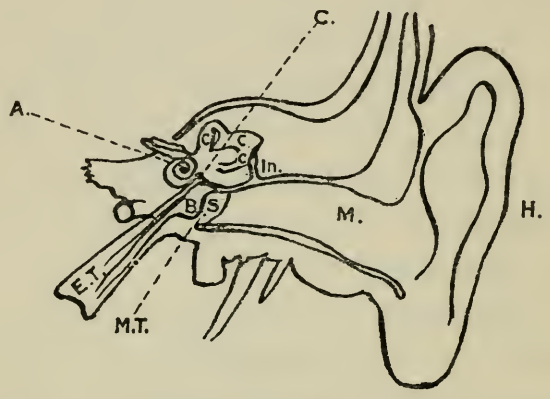


Diagram of Ear (Schematic—in Section).

H, Helix; *ET*, Eustachian tube; *M*, external auditory channel; *MT*, membrana tympani; *A*, cochlea; *B*, tympanum; *C*, semicircular canals; *S*, stapes; *In*, incus.

canals, and the cochlea. The vestibule is just behind the tympanum, and into it opens the fenestra ovalis and the fenestra rotunda. The three semicircular canals open into the back of the vestibule, while anteriorly this leads to the cochlea, which is twisted round a central pillar called the *modiolus*.

The membranous labyrinth lies in the bony

labyrinth, but does not fill it, and the space between the two is occupied by liquid (perilymph). In the semicircular canals the membranous labyrinth is covered with fine hairs, connected with nerve fibres and furnished with granules of carbonate of lime, called otoliths. In the scala media or membranous lining of the cochlea is the essential organ of hearing (organ of Corti). This lining is furnished with the fibres of Corti, placed like bows, and numbering about 3,000.

Stimulus.—The physical cause of sound-sensation is vibration of the particles of the air, set going by vibrations of the object. The vibrations are wavelike, and, as in the case of light, we can distinguish amplitude (which governs intensity of sound), wave-length (which determines pitch), and complexity (which decides timbre).

When waves of sound strike the outer ear, some are reflected back and lost, while some are reflected at various angles so as to enter the auditory canal. The stimulus is then transmitted along the canal, partly by its walls, and partly by corresponding vibrations in the air contained in the canal to the head of the drum, the tympanum. The peculiar position and shape of this cause most of the vibrations reaching it to strike it perpendicularly, and in the most advantageous direction. This membrane responds

exactly to the number, intensity, and complexity of the vibrations, and the latter are transmitted to the inner ear partly by the air contained in the tympanum, but chiefly by the small bones connecting it with the *fenestra ovalis*. When the latter has been thrown into vibration, it transmits the vibration to the fluid of the labyrinth, and so to the minute hairs of the semicircular canals and the fibres of Corti in the cochlea. These affect the auditory nerves, which convey the sensation to the brain.

General Characters of Auditory Sensations.—Before a sensation of sound can be experienced, a certain amplitude of vibration is necessary. From data founded on experiments with organ-pipes, A. Töpler and L. Boltzmann state that the ear is affected by vibrations not greater in amplitude than ·0004 at the ear, or 0·1 of the wave-length of green light. Lord Rayleigh concluded that the vibrations required to influence the eye and ear are of the same order of magnitude.

Sounds are of two kinds, *noises* and *tones*. *Noises* are sounds produced by irregular or non-periodic vibrations; *tones* are produced by regular or periodic vibrations. Even in noises, tones may be distinguished by an educated ear; while musically unrelated tones produced together give noise, as when we sound at once several

adjacent notes of the piano. To excite a sensation of a continuous musical sound a certain *number* of impulses must occur in a given time—generally not less than 30 (for below this number the individual impulses can be perceived) nor more than 30,000, above which few can distinguish any sound at all. The figures vary with individuals, and at different ages, as also does the amount of *perceptible difference* of pitch.

PITCH depends upon the length of the sound-wave, high tones being produced by short waves (large number of vibrations) and low notes by long waves (small number of vibrations). The musical tones which can be used with advantage range between 40 and 4,000 vibrations per second, covering six or seven octaves.

The TIMBRE of a note is due to the wave-form —*i.e.*, to the simplicity or complexity of the wave, and is the characteristic by which we distinguish from what instrument or source it proceeds. For most of the waves of sound that reach our ears are compound, made up of different waves, each of which alone could give a single tone. The ear is apparently so constructed that it can resolve complex wave-systems into simple tones. On listening to a sound of any kind, we recognize it as of a certain pitch. This depends on the number of vibrations of one tone, distinguished as the FUNDAMENTAL or GROUND tone, or first partial tone.

Timbre is due to the complexity of the sensation, to the number and intensity of other tones added to the fundamental tone. These other tones, called *harmonic partial* tones, or overtones, are related to the fundamental tone by harmonic intervals, being *multiples* of the latter, thus:

	Fundamental Tone.	Upper Partials or Harmonics.								
Notes* - -	do	do	sol	do	mi	sol	si♭	do	re	mi
Partial tones	1	2	3	4	5	6	7	8	9	10
Number of vibrations	33	66	99	132	165	198	231	264	297	330

A moderate number of the lower and partial tones, with the fundamental, makes the whole richer, fuller, softer, and somewhat higher in pitch. A large number of the higher overtones of considerable intensity, especially if very high, produces a brilliant, penetrating, and sometimes harsh effect, as in the case of a brass band. The harshness is due to beats between the overtones.

Harmony and Discord.—When several notes sound together, we may get peculiar feelings of pleasure and pain, according as the notes run into and help each other, or are at variance and antagonistic, and this depends upon the vibration numbers of the various tones. The octave (1 : 2) the twelfth (1 : 3), and the double octave (1 : 4), are absolutely consonant sounds; the fifth (2 : 3) is

* *Encyclopædia Britannica.*

quite consonant. Then dissonance gradually increases through the fourth (3 : 4), major sixth (3 : 5), major third (4 : 5), minor sixth (5 : 8), and the minor third (5 : 6). Helmholtz explains discord by the theory that the overtones make "beats" together, yielding a sort of *grating*, which is unpleasant. Consonance exists where there are no beats, or beats too rapid for their effects to be perceptible. Wundt held consonance to be due to a strong resemblance among the overtones of the notes which harmonize.

General Theory of Sound Sensation.—The explanation generally accepted is that of Helmholtz. The immediate stimulus to the auditory nerves is given by vibrations of the drumhead—the basilar or tympanic membrane. It is clear that the air vibrations which affect this membrane have been combined into one wave by the channel of the outer ear, whatever their source or character. None the less, though only a single wave reaches the membrane, that wave has in it the varying characteristics of the different waves composing it. Now, the membrane consists of various strands of different characters, each of which vibrates only in response to certain kinds of tones or overtones related to them, just as the wires of a piano will vibrate only in sympathy with particular notes of tuning-forks sounded near them. Thus, however complex the physical

sound-wave may be when it reaches the membrane, it produces there not a single complex vibration, but a series of different vibrations corresponding to the varying characters of the wave, and these in turn are separate stimuli affecting the terminations of the auditory nerve connected with the membrane.

Hearing with two ears does not apparently much influence sound sensation, but the use of two organs probably obviates errors of the sense and helps in *localizing* sounds; for it appears that judgment as to the direction of sounds is formed partly from the difference of intensity with which they are experienced by two ears.

CHAPTER X

OTHER SENSATIONS

TASTE AND SMELL.—Very little of psychological interest is known of these two senses.

The terminal organs of taste consist of taste-bulbs or taste-goblets, discovered in 1867, situated chiefly in the posterior part of the tongue surface, at its tip and margins, and also in the glosso-palatine arch and parts of the soft palate.

Most of the sensations of taste are really due to odours. If the eyes be blindfolded, and the nose held so as to obviate smell, the tongue cannot distinguish between a slice of onion and a slice of apple. Further, all taste sensations appear mingled with and modified by *touch* sensations, and some of them also by *temperature* sensations. Thus acids and salts produce a stinging sensation, which may become so powerful as to overcome *taste;* and hot water gives a different sensation from cold water.

The taste sensations proper appear to be *sweet*, *bitter*, *acid*, and *salt*. These sensations are not

discriminated equally at different parts of the organ of taste. Sweetness is generally best experienced at the tip and sides of the tongue, bitterness at the base, acidity at the edges.

Insoluble substances placed in the mouth can produce sensations of touch and temperature, but not of taste, which can be stimulated only by fluids. The nervous impulse on which depends the sensation is probably due to *chemical* change.

Smell.—The sensation of smell is due to the contact of certain substances with the olfactory membrane situate in the nose. The substances must be gaseous, and in a finely subdivided condition, and they must be driven forcibly against the membrane. The sensations have not been classified, although they vary considerably. The mode of action is probably chemical.

Sensations of smell are often modified by *touch* and *taste* sensations. Thus the pungency of such a smell as that of ammonia is due to the effects of touch on the membrane. The intensity of smell depends upon the area of olfactory surface affected. The organ is readily exhausted, and soon ceases to respond to the stimulus when it is increased.

In the life of animals the sense plays a much more important part than in that of men, and

by it they obtain much information that man gets by other senses or not at all. By it animals scent and pursue their prey, and also avoid dangers. It is difficult to revive ideally sensations of smell, and probably because of this smells are a very useful means of reproducing presentations with which they have been associated, the association with presentations being very strong.

Sensations of Touch, or *Cutaneous Sensations* as they have been called, are chiefly of three kinds—touch proper (temperature sensations), touch in conjunction with organic sensations, and touch combined with motor sensations.

Touch Proper.—The end-organs of touch in man take three special forms—(1) The *end-bulbs* of Krause; (2) the touch-corpuscles of Wagner and Meissner; (3) the Pacinian corpuscles—and are found in various parts of the body, but especially under the skin of the fingers and hands.

We rarely get sensations of touch proper *alone*, but generally modified by temperature and motor sensations. Touch is probably, from the biological standpoint, the first distinctly differentiated sensation, and still holds a primary position in our mental life as a means of adaptation to environment and of knowledge of the objects surrounding us.

In order that sense of touch may be excited, neighbouring skin areas must be subjected to different pressures. Thus, if the whole body is equally immersed in a liquid, sensation of touch is not excited in each part of the body, there is a general massive sensation. If a limb be immersed in mercury, the pressure is felt only where the part of the limb not immersed meets the mercury. This applies to pressures sufficiently marked to attract attention. Our bodies are continually subject to touch sensations which we do not notice—the contact of our clothes and the like.

The sensitiveness to touch of the skin varies in different parts. The degree of sensitiveness is determined by such an instrument as the æsthesiometer of Sieveking, an instrument consisting of two points as of a compass, one of which slides along a graduated scale. The greater the sensitiveness of the area experimented on, the smaller must the distance between the two points be to give two sensations of touch. If the area is comparatively insensitive, the two points, when separated only by a short distance, yield *one* sensation. The fingers, tongue-tip, and forehead show the greatest sensitiveness. Some of the results arrived at by such experiments are given on p. 149.

	Mm.	Inches.
Tip of tongue	1·1	(say 0·04)
Third phalanx of finger (palm side)	2-2·3	(say 0·08)
Red part of lips	4·5	(say 0·16)
Second phalanx of finger (palm side)	4-4·5	(say 0·16)
First phalanx of finger (palm side)	5-5·5	(say 0·2)
Tip of nose	6·8	(say 0·25)
Centre of palm	8-9	(say 0·33)
Lower third of forearm (front) ...	15	(say 0·55)
Plantar surface of great toe ...	15·8	(say 0·59)
Forehead	22·6	(say 0·85)
Back of hand	31·6	(say 1·18)
Neck	54·1	(say 2·02)
Middle of neck	67·7	(say 3·52)
Upper arm, thigh, centre of back	67·7	(say 3·52)

These experiments show that the skin is sensitive, and also that we have the power of distinguishing the part touched. This is called the Sense of Locality. The greater the number of sensory nerves in a given skin-area, the greater is the degree of accuracy in distinguishing different points of contact.

The power of discrimination improves with practice, and is better across the long axis of a limb than in it. It also differs in different persons, and even with the same person at different times.

Bodies similar in size, weight, temperature, and shape yield different pressure sensations according to their texture. A body of rough surface yields a contact consisting of a number of separate points, as contrasted with the sensations of one broad

contact yielded by a smooth body. A sharp is distinguished from a blunt edge simply by yielding less extent of contact in the surface touched. Hardness and softness are distinguished by the difference in intensity of the pressure sensations. "Just as the partial tones combined in a musical note produce by their union a specific experience distinct from the quality of any of them taken separately, or of all of them taken together, so the combination of pressures which we experience when velvet comes in contact with the skin produces those peculiar modifications of consciousness which we call softness and smoothness" (Stout).

Temperature.—Temperature sensations are of two classes—the *cold* and the *hot*. These are not different degrees of the same nerve energy, but specifically distinct sensations. The sense organs are the whole skin, the mucous membrane, etc. Experiment has proved that there are in the skin "heat-spots" and "cold-spots" which are distinct from each other, and again from pressure-spots. The use of a blunt needle will discover spots which are sensitive to pressure and others which are not. A pointed brass cylinder, dipped in hot or ice-cold water and passed over the skin, will reveal the existence of *hot* and *cold* spots. In a given area of skin all three kinds of spots may exist

It is to be observed that the sensation of heat or cold is excited by *change* of temperature—*i.e.*, there must be a sudden increase or decrease in the temperature of the part of the skin affected. Normally, although different parts of the body are of different temperatures, we do not notice this. Discrimination of temperature is thus like that of *touch*, which we saw is excited by *change* of pressure. Both, of course, are special embodiments of the general law that consciousness is due to *change* of the presentation-continuum.

It will be seen that the skin is far from being a simple organ. It is, on the contrary, highly diversified. Scarcely any two parts of it are alike anatomically, and any stimulus may touch nerve fibres of many different functions.

Muscular Sensations are the sensations derived from the contraction or relaxation of muscles. They appear to be excited by irritation of sensory nerves passing from the muscles themselves, the view that they are due to stretching or relaxation of the skin being no longer tenable. Such sensations play a great part in our perceptions of weight, pressure, and space-relations (*q.v.*). To estimate the weight of an object we lift it, if possible, so getting from the addition of muscular sensation and joint movements a better estimate than would be yielded by touch alone. "Weber found that whereas one-third must be added to a

weight resting on the hand for the increase to be felt, the same hand actively 'hefting' the weight could feel an addition of as little as one-seventeenth."

It is to be noted that muscular sensation is practically always accompanied and modified by sensation of movements of *joints*. In moving a limb we have the feeling of the joints gliding over one another, and so on. Further, the tendons play a great part in sensations of resistance.

Innervation Sense—In addition to these muscular sensations, which are peripheral in origin and result from actual movement of the organism, it has been held (especially by Bain and Wundt) that there is a sensational experience connected with the initiation of the movement by discharge at the nervous centre, quite apart from the sensations produced by the movement itself. The existence of such sensation is now generally denied, and certainly no evidence has been adduced which cannot be explained on other grounds.

Pain.—Besides touch and temperature, pain is a third sensation often referred to the skin. Its physiological character is not yet known, but researches point to there being separate end-organs in the skin which convey the pain sensation to a separate centre.

It is common experience that all sensations, after reaching a certain intensity and becoming

"too strong," are painful. As regards the skin, this limit is soon reached, and is so powerful as to overcome the specific quality of the stimulus. Heat, cold, and pressure give no distinct sense-quality when extreme; they then yield only pain.

Organic Sensations.—Some of the chief points in connection with organic sensations have already been stated. They may persist a long while after the external agency producing them has ceased to operate (*e.g.* a bruise, or cut, or wound), and they produce a general effect on the whole organism. At any moment our general feeling depends upon organic sensations; we feel well or comfortable or otherwise, and this massive whole, compounded of manifold organic sensations from different sources, is what is called "common sensibility," or cœnæsthesis.

An important fact is that organic sensations are much more easily reproduced than special sensations. Thus, the mere threat or anticipation of tickling will produce the organic sensations proper to such a state. The sight of disgusting food may produce actual nausea. This reproduction is due to the fact that organic sensations are bound up with, and partly produced by, central nervous changes, and may therefore be readily reproduced by anything setting up again such central nervous discharges.

CHAPTER XI

COGNITION

We have now dealt with sensations, the immediate data of consciousness, the units of mental life, the materials of the intellectual edifice, but we have still to investigate the manner in which these materials are taken and used by the subject in constructing that world of interrelated phenomena which we call his "knowledge," or those ideal systems which in the man of facts we call "science," in the poetic man "imagination," in the political philosopher "Utopias." In the structure and working of the brain we have shown the machinery of mind; in sensation the material shaped. We have now to consider in what way the mind handles its machinery and materials to produce our world.

We have already indicated that this is chiefly, in its earliest stages, a process of analyzing the buzzing confusion which may be regarded as the infant's first experience, and we have also to bear in mind that no one begins really at the beginning and builds up his world entirely from the egg.

In our physical structure and nervous processes, in our cerebral characters, we bear the results of our forebears' world-experiences. Contrary to Locke's view, the mind is no *tabula rasa* on which may be written what chances to the individual. What is transmitted is of course not a knowledge of concrete facts, but a tendency to act in certain ways in certain conditions. A man does not know trigonometry because an ancestor was a Cambridge Wrangler, but he may have an hereditary bent towards mathematics, which, on opportunity, will show itself. No man is born an international footballer, but he may inherit the peculiar physical and mental conditions which would make him a skilled player in appropriate circumstances. Especially, perhaps, hereditary tendencies are shown by the fact that different people are interested in, and attracted by, different things. Education, environment, gives us interests of various sorts, and often we become interested in subjects to which at first we were averse; but it is clear that interests differ in different persons from the very beginnings of mental life, and this is probably a matter of inheritance. It is not mere chance that sends one man to the cannon's mouth and another to the scholar's study, "seeking the bubble reputation."

Instinct.—In the lower animals this inherited tendency to act in certain ways in certain con-

ditions is very marked. The building of the dam by the beaver, the ordered actions of a community of bees, the migrations of birds, all are "instinctive" activities, which have been stamped into the race by success in the evolutionary struggle for survival. By instinctive we mean due to the character of the animal, not to conscious pursuit of ideally represented ends. It must, however, be at once conceded that the distinction between instinctive and rational action is not clear; the former merges imperceptibly into the latter. The beaver will construct his dam in varying conditions exactly as though a conscious will directed his movements, adapting them to changing circumstances to attain the end, as if he had in clear view that purpose. In fact, each step in the process is *perceptual*, depends on what the animal *perceives* in his environment at the time, and instinct then prompts the appropriate action. Such action is distinguished from reasoned process by the absence of activity of the higher nervous centres. To this extent it is comparable with *reflex* action, the unvarying, inevitable response to certain stimuli such as tickling. Reflex acts are, however, single, not a series. Instinctive actions are usually a series of separate movements co-ordinated to bring about (though not consciously) a certain state of things necessary for the well-being of the individual.

Thus, man brings to the world he is born into a possibility of receiving sensations, a possibility of reacting to them, and tendencies to react in certain ways, mentally and physically. In our remarks on the activity of the subject (p. 76 *et seq.*), the continuity and unity of mental life, association and reproduction, we have indicated the lines on which the mind proceeds in passing from the consciousness of sensation to their interpretation as properties of an external world in which the subject is himself a part. The infant, driven by natural needs and by curiosity, begins to analyze his sensational content. He early discriminates his mother's breast from other objects of touch, and the satisfaction of hunger which makes him seek the mother gives him probably his first experience of pleasure or relief from pain. Even at this early stage, however, discrimination is not alone exercised. The child, in distinguishing his mother from the rest of the world, joins up the various sensations of warmth, food, caresses, shelter, in his experience of what later he will learn to call "mother," and begins to acquire some knowledge of her connection with other surrounding objects.

This example illustrates a point we wish again to impress upon the reader—the unity of the mental life and its organic character. The stream of consciousness is not to be considered as made

up of various related sensations and their reproduction by association, one added to another to form a new whole, as a child builds a castle out of so many separate bricks. Our mental life is the stream of consciousness, and the whole of that stream. For clearness of exposition, for purposes of classification, we may analyze it as we will, but it remains a stream in which all is contained, not in separate boats and cargoes and islands on its bosom, but in its whole mass and movement and intimate personal character.

Perception. — Probably perception, the discovery through sensation of "things," is one of the earliest activities of the self. We have seen above (p. 60) that *pure* sensation is a myth in conscious mental process. Sensation gives us by association with ideas (the result of past experiences—see remarks on "Learning by Experience," p. 99), something more than itself, a meaning or "percept," and one of the first of these is the idea of things from which the sensations are derived. Such a percept ("the consciousness of particular material things present to sense"—*James*) * is due to a combination of sensational processes with reproduction of past experiences. Present sensations of colour (yellow) and shape call up past experiences

* Mill defined *thing* as "a permanent possibility of causing sensations," and *mind* as "a permanent possibility of having sensations."

of juiciness, sweetness, softness, etc., which we have learned to know as qualities of "orange," and so we get perception of the object present. The name is simply a convenient shorthand way of tying up all the essential attributes of the object in one word, which, when used, tends to recall the attributes with which it has been associated in use. This brings out another important consideration, that just as inherited physical and mental tendencies assist in the interpretation of the world, so the authoritative statements of relatives and teachers help the child to understand and retain the experiences he receives. The names of objects are told him, their uses explained, and their essential attributes stated. So he learns much by the results of the mental processes of others, without going through the whole of such mental processes himself. Especially do names assist mental development, and for all higher thinking they become indispensable. For to remember and refer to every object by reproducing and stating its essential attributes would be a process so cumbrous as to render impracticable any but the simplest communications. Anyone who has attempted to express in a foreign language a thing for which he does not know the foreign name and which is not in physical presence, has some idea of the value of nouns and their summarizing character.

Perception depends upon the presence of an external object, and so differs from other forms of cognition, which work by means of ideally revived images. Clearly, perception is a pre-condition of such images; we cannot reproduce until we have had the percept; we cannot form imaginative pictures of the orange-groves of Spain until we have acquired experience of oranges and growing plants.

The motive to perception, as to all other mental processes, is desire, the striving for something which will afford satisfaction—the satisfaction of innate energies, the attainment of ends necessary for the well-being of the individual or the race. Perception is not a passive state, and one of the essential features of its activity is *attention*. For the needs of the moment, the particular appetence or aversion of the time, the present direction of conation (these are roughly synonymous phrases) determine what part of the stream of consciousness shall be *attended* to—that is, shall be allowed to become the object of mental process (see also *supra* as to Attention, p. 83). What parts of the object perceived are essential attributes of the thing at the time is also determined by the direction of conation. At one time the speed of a train, at another its machinery, at another its route, will be the interesting attribute to which attention is given.

Although perception depends upon present sensations and reproduced experiences, it is not meant that this state of mind is a compound, and due to a "fusion" of such experiences. The mental process in an act of perception is unique, different from all others, and though conditioned by such sensations and images, does not *contain* them as parts in a whole. The stream of consciousness does not cast back to us, as in an eddy, the items of past experience to be added to present sensations; its *nature* is altered by such past experiences, and their results are part of the present stream, affecting the immediately given sensations.

Discrimination.—Interest determining the object attended to, in what way do the qualities in that object become discriminated by the mind? To begin with, it may be said that no quality will be discriminated as part of a whole which has not already been otherwise experienced by the subject, either separately, or associated with different objects. A mind with no experience of yellow would never *distinguish* that quality in the orange. If all streets were dirty and all dirty things were streets, we should not discriminate between dirtiness and streets. Discrimination, in short, involves inward reproduction. If we have known and can have an image of a quality *a* apart from its occurrence in a compound *abcd*, we can, on

presentation of that compound, analyze out *a* from the total impression.

Very few qualities of the world are presented to us in isolation, but the discrimination of a quality *a* is made possible by the fact that it occurs at different times with different concomitants (at one time *abcd*, at another *aefg*), or when it occurs with the same concomitants its *intensity* in relation to *bcd* is not the same. In the first case we get "dissociation by varying concomitants"—*i.e.*, a quality associated at different times with different things tends to become *dissociated* from all, to be abstracted from association with concrete things, and to be conceived as a quality which may, or may not, inhere in particular objects, and can be contemplated apart from sensation-given reality. This ABSTRACTION is a step from *Perception* to *Conception* (*q.v.*).

Besides the more difficult singling out of differences in a compound, there are certain differences directly *felt*, and others inferred. Such differences as black and white, rough and smooth, round and pointed, are due to the awakening of *distinct* nervous processes. Such differences must be great enough to attract attention, and are best discriminated when the sensations fall successively, not simultaneously, and in *close* succession. Differences are *inferred* where we know sufficient about each of two things by itself to

be justified in classing them under different heads.

It is well known that "practice makes perfect" in motor accomplishments like billiard-playing, which depends largely on sensory discrimination. A much advocated method of acquiring proficiency in such sports is that of discriminating carefully the parts of each stroke, and practising them piecemeal. Such people as tea-tasters are known to acquire by practice a wonderful discrimination of taste.

Association.—So far we have dealt with discrimination in the process of perception, but, as already indicated, association proceeds side by side with the former in our education. Just as objects appearing at first as wholes are analyzed into parts, so these parts are synthesized to form more clearly apprehended wholes in the mind. Analysis and synthesis are the two aspects of mental activity, each being as necessary for development as is each arm of the scissors for cutting. The working of association has already been dealt with in Chapter VI.

Briefly, Perception involves—

1. Revival of past experiences (by association).
2. Localization of the percept in space (due chiefly to *motor* experiences, which have shown us objects moving through

space towards or away from us). See Chapter VIII. and Space Perception, *infra.*

3. Grouping of the sensations in certain relations, to form an object (due to association).

The qualities, or characters, which are cognized in perception are—

1. *Reality.*—This, which has been the subject of endless discussion from the very beginnings of philosophy, is rather a characteristic of all the qualities which are described below than a separate quality added to them in perception. The psychologist is not concerned with the ultimate analysis of reality. By him it is best viewed as the quality characteristic of his stream of consciousness when *sensational* attributes are present (see *supra*, Chapter III.).

2. *Impenetrability*, the knowledge of which comes by the *resistance* experienced in contact with bodies. This resistance to muscular movement gives us most directly the consciousness of the occupation of space by bodies, and is one of the fundamental bases of external reality.

3. *Unity and Complexity.*—Every object, made up for perception of a group of qualities *abcd*, recurs constantly in connection with other objects, *efgh*, *jklm*, etc. The sensations given by *abcd* are invariable, the sensations given by the other objects

accompanying it vary as these objects differ from time to time, and as the general field of observation alters. Hence comes perception of the unity of *abcd*, together with the complexity of relations of this group of qualities to other groups.

CONTINUITY.—Hence, too, we get our consciousness of *continuity*. The one continuing thing we directly know is our body, and from its continued existence we get the idea of continuity of existence of other bodies which from time to time recur in relation to it. Because they *recur* to our continually existing body we impute continued existence to them. (This is also the basis of IDENTITY. Each knows his own body is for him a presentation always continued. Other things are at first regarded as other persons, as may be early seen by watching young children, and we carry over to these other things, when they recur, the cognition of continued existence, and consider as *one* thing, however often it recurs, whatever has been once perceived as a thing.)

Substantiality.—So far we have considered the synthesis of sensor and motor sensations *a*, *b*, *c*, *d*, into groups (*abcd*), and the relations between such groups. It remains to indicate the qualities *in* each particular group and their relations. Various classifications of these qualities have been made—*e.g.*:

(*a*) *Primary and Secondary* qualities: the Primary

being such as are common to all bodies, and inseparably associated with the idea of things (such as resistance, motion, rest, substantiality); while the secondary (such as colour, smell, and taste) are of the nature of accidental attributes, not essential to the percept of the *thing*, but merely qualifying the percept.

Spencer classified attributes as—

1. *Statical*—such as size, form, position—derived from the object as PASSIVE.

2. *Dynamical*—sensations of smell, taste, etc., as where the subject is passive and the object moving.

3. *Statico-Dynamical*—sensations of muscularity, such as resistance, weight, etc., where the object is passive, and the subject is active (handling, moving, etc.).

There is, however, as Dr. Ward emphasizes, one quality always present and all-enduring—Substantiality, which from different aspects is considered as weight, or resistance, or impenetrability. This we tend to consider as the seat of all the qualities we project into the percept. What occupies space is for the psychologist the Substantial, the other real constituents are the properties of this—the marks which lead us to expect the presence of Substance.

ILLUSIONS.—Perception being an activity of the mind, which contributes images and associated

suggestions to the percept, error is possible, and does, in fact, frequently occur. The sensations are not susceptible of error; you either have a sensation or you have not; but the interpretation of the sensations may be wrong. When there is an objective cause of the sensations, mistaken interpretation or "false perception" is called *Illusion:* where there is no objective cause the phenomenon is called *Hallucination.*

Illusions are due chiefly to two causes:

1. *Similarity of Presentations*, which leads us to attribute to a sensation the cause which usually produces such a sensation. Thus, the rumbling of a distant cart is mistaken for thunder, because the sound is similar to that usually so produced. The oldest example of such illusions, given by Aristotle, is that of a pen-holder or pea held between two adjacent fingers, which have first been crossed. The object held seems double. Usually the touched sides of the two fingers are not together in space, and generally do not touch the same thing. Thus the one thing now touching them is believed to occupy two positions in space, and so to be two things.

2. *Suggestion or Preperception.*—When the mind is full of a particular object, sensations are likely to call up this object. Conjuring, ventriloquism, art (painting), acting, are all illusions of this kind. The "atmosphere" is suggested, the mind is pre-

pared for certain objects, and the physical phenomena brought forward are duly interpreted in the sense desired. "Twenty times a day the lover, perambulating the streets with his preoccupied fancy, will think he perceives his idol's bonnet before him" (James).

Hallucinations.—Here there is no external objective cause, and the hallucination is due to disease or changes in the condition of the blood, physical exhaustion, action of drugs, or other physiological factors. Probably, in many cases of hallucination, there *is* an external objective cause, but the secondary cerebral reaction is out of all proportion greater than the sensational impulse. Such common hallucinations as seeing people who are miles away at the time are well known.

Perception of Space.*—Of two percepts—Space and Time—something further should be said, in view of the important part they play in mental life and their philosophic interest.

"What is Space?" is not a psychological question, but metaphysical and teleological. The psychological question is, "How do we know Space?" Much has been written on the subject, one of the great debating-grounds of philosophy,

* The student should read again Chapter VIII., "Vision of Solidity, or Third Dimension," before continuing here.

but the opinions expressed may be grouped under two heads :

1. The *Nativist* hypothesis—that knowledge of space is intuitive, part of the original equipment of the mind. This was Hamilton's view, and later was set out in more acceptable form by Kant.

2. The *Experientialist* hypothesis—that the idea of space is genetic, in exactly the same way as any other item of knowledge, that it is formed from the experiences obtained by *touch* and *sight.* This view was expounded by Bain, Robertson, Herbert Spencer, and others.

It seems fairly clear that space-perception is derived from sensations of *extensity* and *local signs* (qualities of many sensations, *vide* Chapter V.) and experiences of movement. Movement in space by itself would give us only the idea of *succession*, the idea you get by moving from one object to another; but when we have extensity of sensation (as, *e.g.*, in a bath), and are conscious of the "local signs" of sensation in different parts (the sensation at the fingers we feel to be different from the sensation at the back), and, further, can explore the body, moving the hand from one part to another, each movement giving its "local sign," we get the experience not only of succession, but of co-existence, of movement from one to another contemporaneously existing part of the body, and so of an extended surface as occupying space.

Our experience is of *filled* space, empty space being an abstraction from that experience. We have chosen this example because it is probable that the child's exploration of his own body yields the first experience of extended matter. He gets by this double sensations of contact, active and passive, with differing local signs according to the parts touched, and so the motions of his hands give him the experience of different points in a continuously existing body (*vide supra*, p. 165, Unity, etc.), which is an experience of space.

The eye helps greatly in space-perception, as has already been explained in Chapter VI. (perception of the third dimension—a special form of space-perception).

It seems at least possible that there is some congenital connection between sensations of extensity and active movements. It is clear in the case of some animals. Thus the chick just emerged from the shell pecks with a precision that apparently can be due only to inherited constitution. It does not need to learn the connection between certain visual sensations and active movements, but has already an accurate perception of distance. In man there is no such clear evidence of congenital connection, but it is possible such exists, and forms the starting-point for the development of space-perception to a high efficiency.

Perception of Time.—Time, like space, is presented to us as limited time. We have no sense of empty time; it is an abstraction, as is empty space. Introspection shows that we can no more perceive a duration without any material content than an extension. In the case of filled time, experiment has shown that the longest duration we can apprehend sufficiently clearly in our minds to distinguish it from longer and shorter periods is about twelve seconds. After that the duration ceases to be a perception, and becomes a mental construction. Guesses at the passage of time where there is nothing in the way of objects (sun and shadows, etc.) or activities (distances walked and the like) to afford guidance, are notoriously inaccurate.

The presentation-continuum gives us a succession of objects, causing successive mental states. But the succession of mental states does not itself give us the feeling of succession. Something more is needed. For any perception of duration greater than that of the few seconds passing by, memory and reproduction are necessary. The twelve seconds' duration we can distinctly perceive, during which events follow one another in a stream, some entering faintly at one end as their forerunners die away at the other, gives us time-perceptions of events as "coming," 'present," or "now," and "immediately past."

Expanding this limited perception of duration through the *reproduction* of past events, with their duration and other associations, we are able to extend our apprehension of time (of course, *filled* time) to cover the whole area of human activities—past, present, and *future*.

It will be seen from what has been said that perception is never *mere* cognition. It is always tinged by conation and by feeling-tone. In itself an activity of the mind, its development and utility are bound up with the multitudinous activities of the individual seeking the attainment of ideally constructed ends in a complex environment. The percept gives pleasure or pain, and is accordingly, through conation, the object of further mental process seeking to retain it and its associated ideas in the focus of attention, or to pass on to pleasanter ones.

Imagination and Ideation.—Before the perception of things has progressed far, we are engaged in processes of ideation and imagination distinct from sensible objects immediately given to consciousness. Perception, as has been already said, necessarily implies the existence for consciousness of objects to be perceived, in connection with which the mental processes are set up. But in cases of reverie and reminiscence and imagination, we have not this sensational co-efficient of mental process. We go over the events of a past holiday;

we indulge in day-dreams or construct Utopias, using ideas or images mentally reproduced without external stimulus.

We have now to ascertain the connection between these "free" ideas or images and those impressions given through sensation by objects present to sense.

Ideas* (or secondary presentations) differ from percepts (or primary presentations)—(1) In being less forcible or vivid. The apple which is physically present to us has greater clearness and "fulness" than the merely reproduced image of an apple.

(2) Percepts have also a much greater steadiness than ideas. The latter are in a perpetual state of flux. Anyone who calls up the image of an apple will observe that it does not remain steadily in the focus of attention as does an apple actually present to sense.

(3) Again, the sense impressions accompanying an image are often very different from those accompanying the corresponding percept. If we perceive a train in a station, we have the properly accompanying percepts of lines, station, officials, passengers, and the like. If, however, we men-

* An *idea* is a presentation, image, or reproduction, which has sufficient independence to be capable of forming a distinct link in a chain of thought. Such ideas are always of an *object*, such as a thing, quality, relation, or event.

tally reproduce the *image* of train, the accompanying sense impressions may be quite inappropriate to the image. Thus, the image is of a train, but the accompanying presentations are of the room in which we are sitting, its furniture, other occupants, and so on. The image of absent food when we are hungry is very differently escorted by sensations from the *percept* of food. No one can satisfy appetite by images, because the accompanying sensations differ from those which would be present in the case of the percept.

(4) Percepts, further, bid independently for our attention as the presentation-continuum varies. We often have different impressions bidding for attention at the same time, and consequently distracting the subject. In the case of ideas, however, the conative tendency of the moment, working by association, determines the images to be revived and attended to. Each *image* calls up, or at least modifies, those succeeding, while succeeding percepts are often quite independent of each other. Thus, in examining a dish of fruit, we have percepts of orange, apple, grape, pear, etc., and each of these competes for our attention. But in reproducing the image of such a dish, only those parts of the whole will be revived in which we are interested, and these in the order of importance to us, without any competition for precedence.

(5) The motor experiences connected with percepts are different from those connected with images. We strain to listen, we move our eyes in perceiving objects, and these muscular adjustments are part of the total experience. In reviving such experiences ideally, although the idea is affected by the motor associations of the original percept, the motor associations of the image at the time of revival are quite different. We feel that the effort is internal, and we get the sensation of strain in the forehead in brain-work, or the abstracted look in the eyes of the person thinking, and these adjustments are characteristic of images as contrasted with percepts.

The Freeing of the Idea.—We have now to consider how these ideas become detached from the sensational coefficient of the percept, so as to be capable of mental revival independently of the reinstatement of the original sensations.

Stages of the progress from Impressions to Images are seen in Positive and Negative After-Images (*cf.* Chapter VI.). Although these are both closely connected with sensation, the one being merely the physical remains of sensation and the other the reaction of exhaustion, both have something of the character of Images proper in that, *e.g.*, they are not affected by movements of the head, whereas an impression is lost or altered if the head be turned away from the object.

"Sense-Memory."—A further stage in the process is marked by the phenomenon of "recurrent sensations," or, as it is often wrongly called, "sense-memory." A sensation, usually one which has strongly attracted attention on its occurrence, sometimes reappears some hours after the physical stimulus has ceased. Here the connection with sensation is less than in the case of positive and negative after-images.

Memory After-Image.—It is probably in what Fechner called the "memory after-image" that we get the earliest form of the image proper. Thus, we pass in the street a man apparently without noticing him. A few seconds or minutes later we become conscious that he was a friend. We often "remember" that the clock has struck the hour, although at the time we seemed to pay no attention to the sound. Especially in vision, if we look intently at an object and then turn away or close the eyes, we can usually get a "memory after-image." These recognitions or images are due to persistence of the image of the impression, which is partly the physical effect of the sensations themselves, and partly of attention to those sensations. They differ from positive after-images in that they do not depend upon the intensity of the sensation, and do not turn into the negative-image as do the latter. They have the form of a percept, but not the characteristics

(localization, projection, motor-adjustment) of sense-impressions. On the whole, therefore, they appear to be "free" ideas in the earliest stage, the stage least removed, from presentation.

We have indicated in dealing with perception how the occurrence of one characteristic or quality at different times in association with qualities different either in nature or in intensity tends to dissociate that characteristic or quality from all, and leave it in the memory as an "abstract" idea which may or may not be true of a particular percept.

The same kind of separation of qualities from sense-given things takes place in what Lewes called "preperception." We have become accustomed to sugar as a white, soft, crystalline powder associated with a sensation of sweetness. One day we get the same sensations of sight, but the associated taste is *salt;* we have mistaken salt for sugar. Henceforth sweetness and also saltness become ideas dissociated from the sensational content "white, soft, crystalline," as we have learned that they do not *necessarily* belong to that content. So by the teaching of experience we learn to break up our percepts into different qualities, sometimes present, sometimes not, and also to find such qualities present in cases where we had not expected them. We begin to think of alternative possibilities in the

case of particular percepts, such alternative possibilities being present only in idea until the subject tries and proves which is correct. Here is clearly a great step from the immediate, impulsive cognition of the percept to deliberate comparison and action. As the individual life progresses and the field of our activity widens, perceptual processes become increasingly complex, and the ideas implicit in percepts accordingly tend more and more to be freed and to become the instruments of Imagination and Thought. For Imagination and Thought are but the sum of the processes of separation and combination carried out on sense material, after that material has been rendered malleable and apt for such processes by independence of actual presentation to sense.

Conception.—So far we have dealt with the way in which separate qualities or characters in percepts are "abstracted," and become free ideas or images no longer bound to a particular sense-presentation. The manner in which complete percepts (engine, house, man, etc.) acquire a *general* significance and become material for ideal construction is similar, but probably takes place earlier owing to the greater importance and more striking character of such objects. The child has an image of man (his father) before he has ideas of the different qualities implied

by the word. Then as fuller experience gives knowledge of the characteristics of other men and things, the *concept* of man becomes richer. As the analysis of percepts into different aspects proceeds, so does the knowledge of those percepts as combining these various aspects increase, and the significance of the image or idea of them deepens.

Conception is simply the process by which we mark off and identify a distinct subject of discourse. The CONCEPT is the "general notion or idea" carried in the memory, as contrasted with the percept directly given by sense. Such general ideas are apparently derived from what is known as the "GENERIC IMAGE," by processes of reflection in which abstraction and comparison play an important part. The Generic Image is the cumulative results of many percepts of an object of a certain class, each percept differing slightly in some feature. Thus we have seen many dogs by the time we form a general idea of what a dog is. These percepts have been similar in most respects, but differ in details—size, colour, breed, etc. The image of dog left by these cumulative percepts (unless the word calls up an image of a particular dog, as it is apt to do if we own one) is termed "generic." It does not reproduce the points of any particular percept, but rather a schematic,

general, somewhat vague image of a four-legged animal that barks, wags its tail, is faithful, domesticated, etc.—a "generic" image. Processes of abstraction and comparison working on this generic image, separating the essential characters from the accidental (*e.g.*, four-legged, domesticated, tailed, etc., are found to be essential characters, while colour, size, breed, and the like are accidental), give us the general notion or concept. These concepts are in process of continual formation and alteration, growing in clearness, distinctness, and accuracy as experience widens. The desire to give them clearness results in DEFINITION, the effort to state in words the precise import of a concept. This is a very advanced stage of thought, the stage to which Socrates belongs.

LANGUAGE.—For the formation of concepts and for thought generally, words or other symbols are necessary (*vide supra*, p. 159). The general idea once acquired is held together and retained by a name, which henceforth stands for that idea, and which when used recalls the idea. To carry out the processes of Comparing and Judging without some symbol which represents the content of the general ideas used is impossible. Thus, to arrive at the judgment that the world is round is practicable when words are used. If, however, we had to recall and

bear in mind the whole content of the idea "world" and of roundness, judgment is impracticable, as the mind could not carry the cumbrous materials. A further great advantage of the use of words is that the verbal image is free from almost all associations except its meaning, while the revived percept tends to bring with it into consciousness contiguous associations which are irrelevant to the work in hand.

The Origin of Language is a question which has been much debated. For the Psychologist the important consideration is not the particular system of external signs adopted, but the psychical functions fulfilled. It is now generally considered that language arose out of natural signs. Thus, in the absence of words, one could communicate certain elementary ideas by imitative gestures—*e.g.*, meowing like a cat, barking like a dog—and this seems the basis of the sign language still in use among certain savage peoples. Language (spoken sounds), used first as natural signs, succeeded imitative gestures on account of its superior adaptability and wider range as well as facility of use.

A riddle much discussed by philosophers is the order of priority of language and thought. Did thought precede language or language precede thought? Logically, it would seem that ideational activity came first, but it could not

proceed beyond a very elementary stage without language.

It seems a case of complementary action. "Language," says Sir W. Hamilton, "is to the mind precisely what the arch is to the tunnel. The power of thinking and the power of excavation are not dependent on the word in one case, or the mason-work in the other; but without these subsidiaries neither process could be carried on beyond its rudimentary commencement."

Imagination is sometimes used for the *reproductive* powers of the mind by which we reinstate past experiences. In this sense it is merely another name for memory. Usually, the word is applied to the *productive* side of mental activity by which we ideally construct what has never been given to us in experience. Such constructions are limited by past experience and by the difficulty, which is due to past experience, of separating or combining things which we have always known to be respectively joined or separated.

Passive Imagination. — There is a *passive* imagination, due to the imperfection of memory. In the course of time certain portions of our experiences fade from our minds, certain intervening links in a chain of events drop out, the automatic processes of revival tend to form recombinations of experiences, and the result is a

transcript of experience modified by the mental processes, and therefore imaginative. Dreams are examples of passive imagination so far as they do not merely *reproduce* actual experience.

Active Imagination. — Active or productive imagination has been described as Constructive Association. For it there are necessary—

(1) A store of material, derived from sense-presentation. This implies retentiveness.

(2) A stimulus to create—the desire to please oneself or others, to escape from the limitations of sense-experience, or to enrich life by adding to the stock of ideas.

(3) Reproduction or recollection, which by association calls up the ideas needed for the purpose in view. The object to be attained is fixed in the mind, and round it are grouped by association such further images or ideas as are suggested by the circumstances of the time. The efficiency of the process depends chiefly upon sound judgment of what images are fitted for the purpose in hand.

The facts or materials used in imagination are not new, and do not constitute the originality of the process. This originality consists in something new in the form or composition of these materials. Thus the materials used by Edison for the making of telephones were not new, vulcanite and wire and electric batteries being

well known. What was imaginative and original was their arrangement by the inventor to produce the object ideally imaged—the transmission of significant sounds through space.

It should be noted that when the creator of an imaginative product communicates his results to another, the realization by the latter through language of this result requires imagination on his part rather of a receptive than of a creative kind. There are, in fact, usually said to be three classes of active imagination :

(1) *Cognitive or Intellective* imagination, such as is used in scientific discovery (creative) and in acquiring knowledge from others (receptive).

(2) *Practical or Constructive* imagination, which serves as a means to an end, such as the hypotheses used by men of science in seeking knowledge, and the contrivances of inventors.

(3) *Poetical or Æsthetical* imagination, in which feeling (emotion) is dominant, as in the whole field of the fine arts.

Fantasy or Fancy is the name given to those uses of the imagination most removed from facts, as in the case of many young children. Imagination has a more serious and practical import than fancy. With years comes greater control of imagination by knowledge—"expectation learns to move along the lines of probability."

To sympathize with our fellows and to extend

knowledge and the æsthetic enjoyment of life imagination is essential. Its absence causes narrowness of view, intolerance and cruelty, closing upon us "the walls of the prison-house."

THOUGHT.—All ideational as compared with perceptual activity involves some degree of GENERALIZATION. We have pointed out that images are much vaguer, much less determined, than percepts, and it must now be noted that this indeterminateness applies also to the *meaning* of the image so far as the whole mental process or "universe of thought" at the time does not define it. Thus, the image of a house may represent property, or home, or architecture. But there is another side to this "generalizing" process, as the mental activity is called, by which ideas originally attached to particular sense-presentations are separated and acquire a general significance applicable to other and different presentations. For the image is revived in a train of ideas which is under the controlling influence of interest in the construction of an ideal whole. Thus, what is vague and indefinite in the several images considered separately becomes, as the train of thought progresses, clear and fixed by their relation to the ideal whole of which they are part. The significance of the image of "house" is fixed for the property owner, the man about to be married, or the architect, by the "universe of

thought" in which the image is revived. Here we see again the allied processes of analysis and synthesis, separation and combination, at work. By analysis, as we have seen, the content of sense-perception is broken up into different characters or qualities which, by contrast with the percept, acquire a general (or, as it is called, *conceptual*) character. By the synthesis of thought processes these abstracted characters are recombined in new wholes.

Abstraction.—The manner in which we "abstract" qualities from the percept in which they occur has been shown in Perception. Generalization and Abstraction go on side by side, for as the character or quality is freed from sense-presentation, it tends to be generalized.

Indeed, Abstraction, Generalization, Classification, and Conception are all different aspects of the same mental process. We form the idea of a class by considering a number of related qualities which we find in the individuals composing the class; we have already pointed out that these attributes are arrived at by abstraction. The mere process of abstraction, of separating a character from all other characters and from the percepts in which it occurs, involves classification, the idea of the individual possessing a general quality which can be possessed by other individuals composing the class; and classification

involves generalization, particular individuals being brought under a general quality determined by the purpose of the classification.

Judgment and Reasoning.—Thinking is the conscious investigation of the relations between concepts. The ascertaining of these relations is expressed in judgments, and results in a modification of the concepts used. Thought has three stages—Conception, Judgments, and Reasoning—to which correspond the *Logical* stages of Terms, Propositions, and Inferences. Whereas, however, Logic tends to regard Judgment (Proposition) as the formal synthesis of two fully determined concepts, the psychologist regards Judgment as coming first, and as being rather the process of forming the concept, or at least of determining or modifying it.

CHAPTER XII

MECHANISM OF THE WILL

The brain contains some three thousand million cells, each one actively producing, energizing, controlling, stimulating, or co-ordinating the physical, the mechanical, the bio-chemical, and the mental energies of man. *One-fourth of these cells, at least, have to do with mind* (Sir Thomas Clouston, M.D.).

The mind is divided into three functions—(*a*) Feeling (or Emotion); (*b*) Thought (or Intellect); (*c*) Volition (or Will). We will first of all consider the *Will.*

Will.—Under Will is included the putting forth of active energy to move our own organs, or to change something about us.

"The peculiarity of action from Will, in contrast to other activities, as the powers of Nature—wind, gravity, etc.—is its being preceded or inspired by *feelings*, or by the pleasures and pains of an individual mind."

Hence, Will has been defined as *action prompted by feeling.*

The action of the Will is prompted in the first instance by pleasurable and painful sensations.

Thirst offers a convenient example of this:

"The sensation of thirst induces at once a series of complicated movements, ending in the relief of the painful feeling; but no man or animal is born with the ability to make a journey to a well whenever thirst is felt."

"The human infant cannot even perform the voluntary act of lifting anything to its mouth."

Three different facts of our nature appear to concur in forming the collective aptitudes of the Will.

The first of these, Spontaneous Activity, has been fully discussed in Chapter II.

Secondly, we have the fact that conditions that coincide with the working of the human organism at its best and highest tend towards pleasure, while, when the machinery is, so to speak, out of gear, we experience pain.

This law controls the first moments of sentient life and directs all movement. If a movement happens to coincide with an access of pleasurable warmth, an animal maintains, and possibly increases, the movement; if the warmth passes into pain, the movement ceases. "The infant sucks so as the feeling is pleasurable, and ceases when satiety comes on."

The third and finally controlling fact is the powers of the mind to retain and compare pains and pleasures:

"An example might be taken from the feelings of warmth and chilliness—both very powerful sensations in all animals.

"One of the most obvious means of attaining comfortable warmth is to crouch and bring all the limbs close to the body.

"A very early experience would connect this posture, accidentally hit upon, with the comfortable sensation; and, by virtue of the primary law of the mind, connecting pleasure with exalted energy, the movement, once coinciding with the pleasure, would be sustained and adhered to, as long as it brought the pleasure; and in course of a few repetitions, a definite association would be formed between the state of chilliness and this mode of relieving it. By a more lengthened and roundabout process more complicated associations would be formed, such as coming close to the warm body of a companion, running into shelter, approaching a fire, going into the sunshine, etc.; but, in all cases, the only means of attainment can be pointed out is (I.) the concurrence of spontaneous movements with feelings of pleasure, or relief from pain; (II.) the maintenance of those movements by the first law of self-conservation; and (III.) the forming of a

link between the two by the force of plastic association.

"The illustration may be varied by viewing the case from the side of pain. The immediate and direct result of pain, from the dawn of sentient life, is to lower active energy for the time, and therefore to arrest whatever movements are in progress; this is the general rule, although there is an important exception in the case of acute or pungent pains, which, in the first stage, stimulate and excite the active members.

"Hence, when a movement happens to coincide with a pain, it is liable to be arrested; a bitter morsel in the mouth makes one cease chewing by reducing the active power for the moment.

"The primitive endowment of the system would lead to nothing further until some chance movement of the mouth tended to get rid of it, which movement would be produced and sustained by the pleasurable feeling of relief, which is the operation of the principle from the other side."

So far we have considered *Will* merely from the primitive standpoint. *Will*, so long as it is simply the reaction of the personality to the primitive instincts, as in the child, is more or less on the animal plane. *Human Character*, or the

educated Will, is dependent on the intellect as well as emotions.

Sir William Hamilton adopted the following division of the Intellect into six faculties:

1. The *Presentative* Faculty, by which he meant the power of recognizing the various aspects of the world without and the mind within, called in the one case External Perception; in the other, Self Consciousness and sometimes Reflection.
2. The *Conservative* Faculty, or Memory proper, meaning the power of storing up impressions, to be afterwards reproduced as occasion requires.
3. The *Reproductive* Faculty, or the means of calling the dormant impressions up into consciousness again. These means are, as stated above, the Associating principles.
4. The *Representative* Faculty, for which imagination is another name, which determines the greater or less vividness of the impressions or ideas thus reproduced.
5. The *Elaborative* Faculty, or the power of of Comparison, by which Classification, Generalization, Abstraction, and Reasoning, are performed. This, in fact, is one —not the only—application of the general power of Similarity.

6. Lastly, the *Regulative* Faculty, or the cognition of the *a priori* or supposed instinctive notions of the intellect, as Space, Time, Causation, Necessary Truths, etc.

To go further than this in these pages would lead us into the problems of philosophy, which is not part of our present task.

To sum up, it has been established that *states of pleasure are usually accompanied with an increase of some or all of the vital functions and states of pain with a depression or weakening of vital functions.*

Will or character accordingly depends to a great extent on health of body as well as health of mind.

Perhaps the best example of the mutual dependence of mind and body is the exhilarating effect of fresh air due to the stimulation of the lungs, resulting in the increased purity of the blood, and the better working of the brain.

CHAPTER XIII

THE UNITY OF CONSCIOUSNESS

The subconscious zone, dreams, suggestion, hypnotism, etc.

We have pointed out that our consciousness is not limited by the focal point of attention.

"It is coming to be recognized that 'consciousness' must be understood in a far wider and more general sense than we have been accustomed to associate with it. Alongside of the active work of the intellect, with which, *e.g.*, we study mathematics or pursue our profession, there is a large, dreamy, half-conscious tract of mind, not sharpened to a single point, like the active intellect, but consisting in a multiplicity of mind-centres (mental ganglia, as we might call them), diffused throughout the body. We knew before that our body was a microcosm or an epitome of the world in which it was found. And now we are learning that the same is true of our minds. Primitive kinds of consciousness have been carried up with us in our ascent from lower grades of being, and survive, dormant but real,

over against the intellect which is the palmary achievement of our race. This residual consciousness (the consciousness which exists outside of the rational intellect) consists largely of instincts and capacities which regulate the lives of other animals, and which were employed by man in his primitive state, but for which he has no use in his present-day existence; modes of receptivity and reaction, which were natural to him in his dreamy childhood, but which are discarded by him in the aggressive, self-assertive, wide-awake condition in which he now lives. Mr. Myers, in his 'Human Personality,' gives a very attractive and convincing account of this inheritance from our 'lowly ancestors.' But probably we have to go deeper still to account for parts of the consciousness which we thus inherit. The rooted attachment to home, and the blind tenacity with which, in the teeth of reason, men cling to life, exhibit a more primitive mode of consciousness than that of animal life. Here we will quote some very suggestive words of Professor Stewart:

"'Transcendental feeling I would explain genetically as an effect produced within consciousness by the persistence in us of that primeval condition from which we are sprung, when life was still as sound asleep as death, and there was no time yet. That we should fall for a while, now and then, from our waking, time-marking life,

into the timeless slumber of this primeval life, is easy to understand; for the principle solely operative in that primeval life is indeed the fundamental principle of our nature, being that "vegetative part of the soul" which made from the first, and still silently makes, the assumption on which our rational life of conduct and science rests—the assumption that life is worth living. When to the "vegetative" the "sensitive" soul is first added, the Imperative (Live thy Life) is obeyed by creatures which, experiencing only isolated feelings, and retaining no traces of them in memory, still live a timeless life, without sense of past or future, and, consequently, without sense of selfhood. Then, with memory, there comes, in the higher animals, some dim sense of a self-dating back and prospecting forward. Time begins to be.'

"This, then, is our starting-point, that besides the single, supreme, rational activity, which we call 'intellect,' there exist in us other forms of consciousness similar to those which accompany the growth of the plant or the life of the animal; and that this residual consciousness, however much we may discard or disown it, continues to live and work, and does things which the proud intellect is unable to do. On the other hand, we must not forget that these forms of feeling and instinct, of perception and reaction, which we

regard as our heritage from lower grades of life, are enormously modified by their juxtaposition with a rational intellect. The unity of nature which comprehends both the intellect and them, makes itself felt; this lower form of mentality is still the mentality of a rational being, and the general position may be described by saying that there exists a decentralized consciousness, diffused through the organism, 'irrational, but capable of sharing in reason, and of listening to it,' as Aristotle would say, and manifesting itself in a power of receiving impressions, manipulating them, and reacting upon them, which, in our present state of ignorance, we describe by the convenient word 'abnormal.'"*

Sir T. Clifford Allbutt, the Regius Professor of Physic at Cambridge, has given expression to the same facts in different terms:

"It is true that we do not know even approximately the content of the individual man, the materials racially and personally acquired, the products of past experience, racial and personal, built sensibly and insensibly into his personality. May we not each of us be compared with a ship which began its voyage with no inconsiderable rudimentary equipment, then, calling at many a port, has gathered many kinds of stores and treasures? Of some of these stores, of some

* Dr. Chandler.

variety of them, the supercargo has a recollection, especially of those in frequent use; but, for the most part, the bills of lading had been lost. Unlike a cargo, however, these contents are not a passive burden, but a system of coefficients; some on planes which we commonly call 'material,' some on spiritual planes, some working on the surface, some working stealthily within."

We can easily see that as each cell has its own "vegetative" life associated with its own chemical processes, there are endless ways in which the human consciousness can work. These various functions of the "attentive" and "subattentive" mind will be considered under the heading of (*a*) Dreams, (*b*) Suggestion and Hypnosis.

Dreams.—Dreams, according to one authority, Dr. Freud, are not, excepting those of children, inspired by conscious desires, but by unconscious ones. "Sometimes, it is true, the manifest content of a dream shows within distortion the fulfilment of a wish of which the dreamer is entirely conscious; more often, also, such a conscious wish is discovered in the latent content on analysis; in every case, however, as appears on fuller analysis, these conscious wishes are associated with, and merely reinforce deeper unconscious ones, which are the fundamental motives to the dream activity. Thus no wish is capable of producing a dream which is not unconscious or associated with

another wish which is unconscious. Only such desires remain in our consciousness as are "acceptable to consciousness." Certain desires cannot possibly be gratified because they meet with actual external hindrances. Others cannot be gratified because their gratification would be incompatible with our duty—our obligations towards others. In either instance, there is a conflict between the selfish individual impulse and objective circumstances—environment; the case being the same whether the hindrance to gratification is physical, lying in an actual impediment, or moral, arising from the individual's regard for law, morality, custom, or the opinion of others. Such desires, since they are incapable of being expressed in activity calculated to secure gratification, are not worth retention in consciousness. They are, moreover, inevitably unpleasurable—painful to the individual, and, because painful, they are, by a defensive process, repressed. These desires, however, are still proper to the individual; they are not removed, but only transferred to unconsciousness; and there remain operative—that is, they are still capable of starting various mental processes. One of these processes is that of dreams. Our unconscious wishes—those which are impracticable, or which are painful, shameful, or otherwise intolerable, and thus are driven from our conscious waking

minds—are fulfilled for us in sleep. And, biologically considered, the function of dream is this—that they satisfy and allay mental activities which otherwise would disturb sleep. By affording a necessary expression or discharge, they secure mental repose. The dream is thus the "guardian of sleep." The function of day-dreams and hallucinations is doubtless the same—to relieve the overburdened mind and secure a comfort not to be found in the presence of reality. Speaking of an apparition, Goethe says: "Whatever the explanation of these things may be, the wonderful phantom gave me, at that moment of separation, some alleviation."

The *Journal of Abnormal Psychology* recently devoted space to an elaborate analysis of dream-states, and refers to the late R. L. Stevenson's experiences as described by himself.

"Stevenson has a 'Chapter on Dreams,' describing his own experience, which is so instructive that if space permitted it should be quoted here entire. 'He was from a child,' he tells us, 'an ardent and uncomfortable dreamer'; as a child he had terrible dream-haunted nights. While a student in Edinburgh, he began 'to dream in sequence, and thus to lead a double life—one of the day, one of the night'—which soon sent him 'trembling for his reason' to the doctor. He 'had long been in the custom of

setting himself to sleep with tales, and so had his father before him.' It is not strange, then, that he 'began to read in his dreams—tales for the most part, and for the most part after the manner of G. P. R. James, but so incredibly more vivid and moving than any printed books, that he has ever since been malcontent with literature.' 'But, presently,' he continues, 'my dreamer began to turn his former amusement of story telling to (what is called) account; by which I mean that he began to write and sell his tales. Here was he, and here were the little people who did that part of his business, in quite new conditions. The stories must now be trimmed and pared and set upon all fours, they must run from a beginning to an end, and fit (after a manner) with the laws of life; the pleasure, in a word, had become a business; and that not only for the dreamer, but for the little people of his theatre. These understood the change as well as he. When he lay down to prepare himself for sleep, he no longer sought amusement, but printable and profitable tales; and after he had dozed off in his box-seat, his little people continued their evolutions with the same mercantile designs.' Thus the scenes of some of Stevenson's tales, for instance of 'Dr. Jekyll and Mr. Hyde,' were first enacted in this dream theatre; and these tales were, as he represents them, a collaboration between himself and what he

calls his 'little people'—that is, between his conscience waking intellect and his dream faculty."

For a fuller study of the subject, reference may be made to Mr. Havelock Ellis's large work on the subject.

Individuals only dream when not fully asleep. It is in the momentary interval before waking that the dream occurs. Women usually sleep more lightly than men, and accordingly dream more than men. The senses are relatively active in dreams as follows :

The sense of sight 60 per cent. of cases listed.
The sense of hearing 5 per cent. of cases listed.
The sense of taste 3 per cent. of cases listed.
The sense of smell 1·5 per cent. of cases listed.

So that in the majority of dreams we see rather than hear, taste, or smell.

Experiments show that twice as many women remember their dreams compared with men.

The Subconscious (or Subattentive Zone).

Suggestion can best be compared with *prompting*. We find the mind a *cue*, as it were, and the mind acts in some given way.

For instance, if one has a note in one's hand, the sight of a red pillar-box will *suggest* posting the letter, although it may be the intention to deliver the note by hand. Examples of this kind might be multiplied without number. The mind,

however, can only be prompted to some line of thought that it already knows. But, granted that, the association of ideas is remarkable.

Suggestion and Art.—"It is the principle of art founded on the nature of the feeling, to leave something to desire.

"To leave something to the imagination is better than to express the whole. What is merely suggested is conceived in an ideal form and colouring."*

Suggestion and Education.—Suggestion is the ideal form for education to take. In other words, scientific education must proceed along "suggestive" lines. A suggestion is always more powerful than a command. By suggestion you are appealing psychologically to the whole mind, both conscious and subconscious.

Hypnotism.—It will only be possible to touch on the subject of hypnotism in these pages. For any adequate account of its phenomena the student is referred to the textbooks dealing with that subject by itself.

Mesmer, one of the first men to make use of the fact that when in a semi-somnolent condition men and women were peculiarly open to suggestions, thought that in hypnotism some mysterious "fluid" passed from the operator to the subject, and accordingly hypnotism was first called

* Bain.

Mesmerism. Mesmer made use of his discovery chiefly as an entertainer, but Liebault at Nancy, in the middle of the last century, took up hypnotic suggestion seriously for medical purposes, and the practice has not at the present day advanced far beyond where he left it.

The study of suggestion and of hypnotism are so closely linked that one cannot well discuss them apart. In concluding this chapter the following instances from a book on "Self-Suggestion," by Samuel McComb, are worthy of note, and will serve to explain the psychology of hypnotic-suggestion in "psycho-therapeutics," to use the medical term.

"A good illustration of this process is afforded by the case of a gentleman who called upon me recently to get some advice as to the method of regaining his self-control. It appears that he had been reading Professor Percival Lowell's lectures on the conditions of life in Mars, and he had been profoundly impressed by the fact that in that planet water is very scarce, and the inhabitants suffer from perpetual thirst. Then he argues, on the basis of this observation, that the Deity who could tolerate such conditions in Mars might regard with complacency the same state of affairs on this earth. Then he began half consciously to visualize the state of this earth when everybody would be suffering from thirst, and

so the process of morbid brain activity went on until he became a nervous wreck. Had he realized just what he was doing, the morbid process would have been nipped in the bud by a hearty laugh."

"Dubois, the Swiss specialist, tells of a patient whose trouble started in this way: On one occasion it was his duty to carry some potted geraniums to another flower border in the garden where he was at work. Following this effort, he was taken with an agonizing cramp in the region of his stomach. He soon discovered the reason of this strange sensation. It was the red of the geraniums which brougut it on. That was his theory, and he found confirmation of this theory in the fact that ever afterwards bright red always produced this effect upon him, and the reaction was just in proportion to the intensity of the red, so that if he took up a book with red edges, the sensation of pain grew and decreased if the intensity of the colour was lessened by turning the leaves over. Dubois pointed out to him that he was simply the victim of an auto-suggestion. Possibly cramp came on the day he first felt it through the attitude of bending the body or through some physical fatigue, or perhaps because he had eaten something that had disagreed with him. One could not tell exactly what was the cause. It could not have been the red colour however, that made such an impression upon his

organs and caused the sensation, because there is no inherent connection between any colour and stomach cramp. That the red always acted in the same way afterwards did not prove anything. He was suffering from the effect of an auto-suggestion, and as a mental suggestion creates a sensation just as long as it is not dissipated by a contrary auto-suggestion, so the patient had remained under the power of his self-produced trouble until he understood its *modus operandi*—the source of its hold on him. This, brought to light, began his cure."

CHAPTER XIV

THE APPLICATIONS OF PSYCHOLOGY TO SOCIAL PROBLEMS

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THE importance of the psychological factors in the formation and control of social phenomena has been recognized, at least in some measure, since the time of Aristotle. Systematic statements of the nature and influence of these factors have been three in number. The first and oldest of these systematizations reached its most advanced formulation in what came to be known in its later developments as Utilitarianism; the second belongs primarily to the last half century and is known in England, France, and America as Institutional or Social Psychology; while the third application of psychological facts to social phenomena — though having its beginnings in the works of Maudsley, Kraepelin, Janet, Lombroso, and other investigators of the abnormal on the one hand, and of the practical English and

German educators on the other—has reached a marked constructive efficiency only in the last decade or two. To this third and rather diverse group, the members of which have in common the fact that they are engaged in making concrete applications of psychological facts or principles to specific activities in a social situation, now belong the newer educators or educational psychologists, the psychopathologists and psychiatrists, and the newer advocates of industrial management and efficiency. In discussing the applications of Psychology to social problems, it will be necessary to take up these three groups in the order here outlined. The value and limitations of the Utilitarian contributions will be considered first.

1. A rudimentary statement of the Utilitarian standpoint was made as far back as the time of Aristotle when that remarkable philosopher put forth the essentials of the self-interest principle of conduct, which was copied from him with some expansion by the French political philosopher, Bedin, in the sixteenth century, and was brought to its greatest development and acceptance by the political and social philosophers of the late eighteenth and early nineteenth centuries. Helvetius in France, Godwin, Bentham, John Stuart Mill, and Herbert Spencer in England, and Lester F. Ward in America, were the leaders

in this species of the application of psychological knowledge to the problem of political, economic, and social life.

In the early stages of this theory of social control through self-interest—indeed, down to the time of John Stuart Mill—it was quite generally held that men acted uniformly and consistently in the direction of their desires or greatest happiness. Bentham, writing in his "Principles of Morals and Legislation," changed the principle of the legitimate motive to conduct from that of the individual's greatest happiness to the greatest happiness of society as a whole. John Stuart Mill, who popularized the word "Utilitarianism" as descriptive of this self-interest theory of social motivation and control, introduced an important supplementary principle to the naïve theories of Godwin and Bentham. He contended that sympathy sometimes—the more frequently the more developed the condition of civilization, he implies—interrupts the direct action of self-interest, either in the individual or in the group, in deciding what line of conduct should be adopted. Thus, a systematic understanding of the needs of others—or vicarious suffering, to put it negatively—frequently comes in to modify the dictates of pleasure, and to give a new direction to the fulfilment of happiness. This hypothesis of the rôle of sympathy was expanded by Spencer until it

became the heart of his theory of social motivation. Its ethical implications were seized upon by Leslie Stephen and Thomas Hill Green, and applied to such an extent that it became the agency by means of which ethics was given a distinctly social turn by these writers. Hitherto ethics had been mainly individualistic, and but slightly functional and social.

Thus there has been a twofold application of the theory of Utilitarianism to social phenomena. On the one hand, the greatest happiness-sympathy category as an explanation and guide to the conduct of individuals in society was brought to a high state of development by John Stuart Mill and Herbert Spencer. In America this view has been taken over substantially by Lester F. Ward, and partially accepted by a number of American sociologists and political economists. On the other hand, Spencer marks the turn in ethical theory where, through the agency of this greatest happiness-sympathy category, ethics was socialized and removed from the position of a mere intellectual discipline to the dignity of a practical guide to life. Hastings Rashdall in England and John Dewey in America are, perhaps, the leading contemporary exponents of this form of ethical theory, which makes ethics practically a division of sociology.

As obviously true as is the Utilitarian self-

interest-happiness-sympathy criterion as a partial explanation of human conduct, it fails to take care of all activities with a social bearing. Indeed, the reputed sphere of the control of these motives has constantly narrowed, until, at the present time, it occupies only a minor portion of the field, and other motives to action or psychosocial forces have been introduced by later investigators of the relation between psychical phenomena and the social processes. The Utilitarians who formulated the self-interest-greatest-happiness-sympathy theory of conduct failed to take into account two facts which, though comparatively simple, were imperfectly understood in their day. The first of these is that the range of the individual's consciousness is so limited as compared with the possible number of stimulus sources that no one person can visualize the complex forces at work shaping the destiny of the world with sufficient clarity and comprehensiveness to be able to determine consistently in any given case what course of action will produce in the long-run either the greatest individual happiness or the maximum social good. Only in a static world in which all possible physical and human movements could be foreseen, measured, and controlled, could such choice be effectively made; and such conditions are impossible. Not only is knowledge lacking with which

to make such a Utilitarian choice effectively, but there is a fundamental conflict between the greatest happiness—either immediate or postponed—of the individual and of society as a whole. The individual's happiness is best promoted by the maximum consumption of goods, economic or spiritual, in his own lifetime. Death separates him from further enjoyment; consequently conservation beyond the span of one life is abhorrent to individual happiness. Yet conservation of social goods, and therefore sacrifice of individual to social interests, is a primary law of social welfare and progress. These two facts break down the universality of the theory of Utilitarianism, which naïvely assumed all conduct to be the result of conscious choice, which was often assumed to be of the most closely reasoned character.

At those points where Utilitarianism has failed to explain conduct or to regulate it for the greater social happiness and good, two other schools of thought have been ushered in—the one to explain and the other to regulate. These are the social or institutional psychologists, as distinguished from the individual psychologists, on the one hand, and the educational and industrial psychologists and the psychopathologists on the other.

2. The work of the social psychologists was quite largely foreshadowed by the investigations

of Sir Henry Sumner Maine in the field of political institutions, and by those of Herbert Spencer and Charles Letourneau in the fields of primitive sociology and anthropology. Thus, the ethno-sociologists are responsible for the initiation of the movement for the modern study and interpretation of social life in terms of organized psychical processes. These investigators, however, studied the organized Psychologies of primitive peoples, while the social psychologists of the present day are concerned primarily with such manifestations in the society contemporary with them. The recent leaders in this movement have been especially Tarde and Le Bon in France, Ross and Cooley in America, and McDougall and Wallas in England.

The work of the social psychologists has had four main directions. First, they have analyzed our institutions and pointed out the grasp which the past, or "dead hand," everywhere present as custom and tradition in our institutional life, has exerted upon the present. Also, they have described in great detail the contemporaneous control maintained by the group mind, or "public opinion," over the lives of individuals, sometimes working in harmony with and sometimes in opposition to custom and tradition. Thirdly, they have brought before our eyes with new vividness the leavening and stimulating effects of

new ideas or inventions upon the thought and action of the time. Finally, they have pictured the struggle that is constantly in process between the new and the old, between custom and convention, between tradition and science.

(1) Custom and tradition are but the objective and the subjective—the activity and the thought—aspects of the same thing. The chief constituents of institutions are customs and traditions, though it is by no means inconceivable that an institution should be constituted primarily, at least in its fundamentals, of contemporaneously organized activities and ideas. The church, as the institutional embodiment of religion, typifies admirably the dominance of custom and tradition. The ritual of the Church in its multiplicity of forms, the observances not included in the official or essential ritual which have grown up as adjuncts to the Church, and the recognized or standardized contacts between Church and State constitute the custom aspect of this institution. The definitely formulated creed, the subsidiary decrees of councils and other bodies or individuals in authority, the commentaries, and, after a manner, the very history of the Church, when it embodies information essential to the interpretation of the creed, are traditional features upon which ritual and ceremony are professedly based, and to which they are supposed to conform. In the institution

of the Church the new is at a minimum. The sources of authority are primarily in the past, and even when innovations are introduced, they come in by the way of reinterpretation of previous ritual or commandment, quite in the same manner as new judicial opinions in the field of the common law are smuggled in under cover of "legal fictions." Indeed, the common law and the machinery of justice built upon it might be cited as examples of institutions primarily constituted of tradition and custom almost as excellent as is the Church.

On the other hand, let us take for illustration such an institution as an Australian or an American Commonwealth. Here the traditional and the customary are not so much in evidence, though they are by no means lacking. The general forms of these Governments are strikingly similar to the English in many particulars, and many of the officials might easily be English with slightly modified duties and other names. Traditional elements have descended from the Mother Country in the forms of the common law, the lodgment of sovereignty, and in such dogmas as the sacredness of private property and the inviolateness of the domestic relations. Yet there is a large body of primarily new conventions, such as the initiative, the referendum, the recall of public officials, suffrage exercised by women, independence of Church and State, education of the youth, and

even of adults, through all grades of studies entirely at public expense. The list of these newer phenomena, which have been institutionalized—though often imperfectly so—could be extended to considerable length. An institution works best, is subject to least friction and interruption, when all of its constituents are of long standing, and are generally accepted as right and serviceable by those who function in it.

(2) Whether new or old, an idea of an activity gets its vogue primarily through a species of social pressures which has been called "public opinion," though there may be little opinion involved when considered from the standpoint of acute or conscious thinking. Particularly if the idea or the activity descends to us as a tradition or a custom through some well-established institution, such as the family, the State, or the Church, it is likely to be taken over quite unconsciously by the individual. The social pressure here operating as "public opinion" is the tradition or the custom itself, or, to state it collectively, the institution. If the thing is new, our acceptance or rejection of it may involve some conscious weighing of its merits, though our interpretation of its merits may quite as well be expressed in such individualistic terms as "It saves trouble," as in the social and ethical judgment, "It is good for society." Or, indeed, we may assimilate it

without any consciously expressed valuation of it whatever. Conformity in such cases may be but temporary, or it may be relatively permanent—that is, the group which has created a "public opinion" in favour of the idea or the activity may soon tire of it and abandon it for some other fancy. On the other hand, the thing may become institutionalized, and, whether good or bad, may not easily be dislodged from its *milieu*. Such phenomena we call "fads" when they are exceptionally ephemeral, and fashions when they are of longer duration, and have some regularity of appearance and disappearance. A fad which has exceptional intensity, and which is likely to spring into existence or to disappear with great suddenness, is termed a "craze." The term "convention" properly applies to an activity which has some degree of permanence, and is regular in its manifestation. It may be either custom or fashion. Quite obviously, fashions and other like manifestations are not confined to the realm of personal adornment, but are to be found in all departments of life, not even science excepted.

(3) This review of the more recently evaluated psychical elements in social life brings us to a consideration of the nature and functions of invention. The term "invention" may be applied quite as well to the production of newly organized pyschical phenomena, such as ideas, suggestions,

fashions, fads, and the like, as to the production of machinery or other material things. An invention is the result of a cross-fertilization of ideas or impressions; it is the birth of a new idea, resulting from whatever complex or combination of psychic stimuli. Inventions occur everywhere, but especially in those fields less institutionalized and less rigidly controlled by custom and tradition. This is so markedly true that we have devised a special term-science (organized knowledge) to cover inventive activities in those fields where inventions are most prolific and most subject to experimentation and regular control. Accordingly, as the habit of invention, or orderly and controlled thinking, invades a field previously controlled by custom and tradition, we say that it is being transformed by science. In this way all the disciplines which we now call "scientific," such as physics, chemistry, biology, psychology, have been rendered exact and experimental.

Inventions, whether mechanical or psychical, whether in the nature of an individual adjustment or of an organization of ideas, activities, or forces, are social. They are social in their origin, for no one ever originates a wholly new process, psychical or physical. As civilization advances to greater complexity, more and more comes ready prepared to the hand and the mind of

the inventor. Likewise, with the growing complexity of civilization and the interdependence of society, the more far reaching are the results of any new adaptation which we call an "invention." The invention of the theory of probabilities—of the voting machine, of an anæsthetic, of the printing press, or of the holding corporation or "trust," affects ultimately all phases of life and transforms all institutions where readjustment to the new order of knowledge and skill becomes necessary. Inventions are the transformers of society. They are social both in their effects and in their origin.

(4) But since every new product of thought and experimentation is an invention, not all inventions are socially valuable, nor are all good inventions immediately recognized as useful. They come into conflict with the established order, and the order as it is has its partisans quite as much as has the order to be. Frequently the two bodies of contestants—the conservatives and the radicals—take quite unreasoning attitudes toward each other, and the principles or programmes for which their opponents stand. The advocate of the new is too apt to undervalue the importance of the old. While it is not true, as is often urged, that what has successfully weathered the storms of the past must necessarily because of that fact be good for the present, it is quite valid to maintain that the

roots of the present are always in the past. Neither human nature and energies nor the resources of nature will permit of a complete transformation of the world of ideas and of things within the lifetime of an individual, nor indeed within several lifetimes. Yet the invention—the new idea or thing—is the true social protoplasm out of which the future is to be built, and it must not be ruthlessly destroyed, as the devotees of institutionalism—of custom and tradition—too often would do.

The problem, therefore, in any one age or in any one community or country is to find the proper rate of social change for those conditions, and to apply it to the problems in hand. The statesman, the publicist, the leader in any field, must choose his material wisely, if he would hold both horns of the dilemma and survive to do his work, which, of course must always point to progress. To the social psychologist, with his evolutionary view of social phenomena, the past and the present are never quite good enough. It is the nature of things to change.

What, then, has the social psychologist done to supplement the imperfect work of the Utilitarian as a guide to and an explanation of the process of making these adaptations—in applying psychological phenomena to social problems? He has accomplished at least three things in this connec-

tion. He has demonstrated that many of our attitudes, of our reputed choices and reasoned activities, are merely the more or less blind acceptances of what is established, or what the tyranny (beneficent or harmful) of the group mind imposes upon us. Perhaps very little of our social action—that is, conduct with reference to the social group—is thought out with reference to the group welfare. Even where active sympathy is involved in making an adjustment, it is quite the exception for it to have anything more than an individual reference—that is, to indicate an adjustment between man and man, and not a co-ordinated adjustment of individuals to society for the greatest happiness of all in the long-run. Furthermore, while the new social psychology has largely removed the foundations from the old Utilitarianism, it has also made a positive contribution. It has shown how ideas and activities actually originate, how they become disseminated through society by the aid of imitation, and under the guise of such social pressures as fashion, conventions, and the like. Finally, it has shown how those phenomena which survive become institutionalized, and in their turn are handed on to other generations as customs and traditions which will be combated by other inventors and discoverers in the social realm. In short, the new social psychology has created a new philosophy of the social

whole. It undertakes to explain—not wholly on an intellectualistic basis, as did the Utilitarians, but more effectively—the organization of society and the process of social change.

3. So much for the broader aspects of the application of Psychology to social problems in very recent times. More specific applications by the psychiatrists and the psychopathologists on the side of pathology, and by the new educational psychologists and the advocates of system or "scientific management" in industry on the other hand, is now under way. Though this phase of the social adjustment of the individual through the application of data from the field of Psychology is of more recent development even than the work of the social and institutional psychologists, it has already accomplished noteworthy results.

(1) Let us consider the normal aspects first. The introduction of system into industrial pursuits through scientific supervision promises to result in the saving of a great deal of time and labour. To take one illustration of results already accomplished, an American works superintendent in the Pittsburg district some years ago had employed some manual labourers to load iron pigs on cars. The method employed was to cause each labourer to seize a pig and carry it up an inclined plane and drop it into the car, keeping this up all day, with intervals of rest. The superintendent found

that his men, working under this method, loaded on an average of seven tons of pig-iron to the person each day. He devised a plan by which the labourers would work and rest according to signals, seizing the burden at one signal, marching at a certain pace and depositing it in its place, and returning for another upon various other signals. Rest periods of graduated lengths were interspersed at such points as were found most efficient in conserving the energies of the labourers. Under the new method of scientifically or experimentally controlled labour and rest, it was found that each man did on an average six times as much work as before, and was no more fatigued at the end of the day.

Another superintendent worked out a method by means of which bricklayers were enabled to multiply their output some two- or three-fold without additional fatigue—merely by having their materials placed before them in a uniform and convenient position, by having the platform on which they stood kept at a uniform and effective distance from the line where the bricks were to be applied, and by instructing each workman in methods of picking up and placing bricks and in handling his trowel in such a way as to eliminate all superfluous motions. In a similar manner it has been found that office labour can be materially reduced by the introduction of methods which

eliminate superfluous movements. Thus, in big establishments the time required to stamp letters has been cut down to one-half or to one-third the former time by arranging the letters in a certain order, having the stamps arranged in ribbons or strands which are drawn between the fingers of the right hand, and applied by the thumb of this hand to the envelopes which have been supplied by the left hand. The thumb of this hand carries a perpetually moist sponge with which to prepare the envelopes for the reception of the stamps.

(2) The efficiency of the learning process among students in the schools has also been greatly increased by such devices as properly alternating rest and study periods, by choosing material for study and illustration which appeal to the imagination and instinctive aptitudes of the students, by properly co-ordinating hand and brain, and by utilizing simultaneously as many of the senses of the student as possible in the learning process, so as to get the advantage of multiple stimulus to the same impression. This last principle of multiplying the number of senses which are brought to bear upon the act of learning is the newest tendency in normal education on the psychological side. It is nothing more nor less than a return to the natural process of learning which the child employs in his every-day life. It is especially important, not alone

because a multiplicity of stimuli is always more effective in securing a definite impression than a single stimulus, but also because the different senses are unequally developed in various individuals. Most of us receive the great bulk of our impressions through sight, as is evidenced by our tendency to visualize objects not physically present to us. Consequently, until very recently, practically all educational methods were based upon the utilization of visual stimuli, and this primarily in the form of the printed page. But it was observed that some students, otherwise apparently bright, were very dull at learning from books. Psychological experimentation has shown that these individuals were not good visualizers, and therefore could not easily translate ideas and facts from the printed page over into actual experience. Some, however, were able to learn much more readily from auditory impressions, in which case they needed to have things told to them in conversations, discussions, and lectures. Others learn best by actually doing something which involves the principle to be assimilated. They need the stimulus of touch and eye measurement.

Such considerations have led more recently to a revolution in teaching, a transformation which is actively in progress. Manual training and vocational schools, the study of the sciences

through experimentation, the utilization of the lantern and the moving picture machine in studying history, art, and current questions, and the methods of observation and doing as applied to all subjects where possible, are examples of the tendencies — some of them already well established—in this direction.

(3) In some respects closely allied with the application of psychological principles to the normal educative process is the work of the psychopathologists who seek to remedy defective sensory adjustments in the young. Much social maladjustment which formerly was attributed to bad instincts and bad heredity is now known, thanks to the psychopathologists, to be due to undeveloped or diseased sense-organs and to other abnormal conditions of the nervous and physiological organism. It is now recognized that most defect is not inherited, and, whether inherited or acquired, in the great majority of cases it can be corrected. The discovery and correction of such defect is the task which the psychopathologists have set out to accomplish.

One of the most effective fields of their labours has been that known as the medical inspection of schools. Physicians and trained nurses, receiving instruction from the Board of Health or from the Board of Education, examine those students who are backward in their studies, and discover the

cause. If it is defective vision, glasses are adjusted, or an operation is performed where it is found necessary. If hearing is below normal, the defect is corrected, when possible, and where it is not possible to restore the complete health of the auditory nerve or otherwise adjust the ear, some other adjustment of the child to the learning process is provided for. In like manner adenoids, defective teeth, organic disorders, as well as cases of contagious diseases, under nourishment, bad home conditions, and the like, are detected and cared for. In some cases the child is placed in special classes for backward children, and is given more individual attention until he catches up with his proper grade. Indeed, the most recent tendency in public education is toward greater individualization in teaching for normal as well as for subnormal school-children.

Similar psychopathic methods are now applied quite extensively in some countries to the correction and prevention of juvenile delinquency. In some of the large cities of the United States, such as Chicago and New York, psychopathic institutes or clinics have been established to seek out the individual causes of delinquency. The social causes are left to the sociologist and the social worker, in particular to the probation officer and the juvenile court judge. But many causes of wrongdoing are individual—that is, they are

the result of organic or mental defect, which prevents the person suffering from them from making a normal adjustment to the world in which he lives. Not being able to do effective work and thus to earn his living, the subject steals, or being of a low grade of intelligence he disregards the ordinary and necessary conventions of life. Frequently the cause of his wrongdoing can be traced back to such elementary factors as defective sense-organs, under-nutrition and consequent anæmia, disease, or to the lack of moral instruction in the home regarding elementary principles of right and wrong, or even to criminal examples set before him in his daily experience. William R. George, founder of the George Junior Republics, relates that one of his charges, up to the time he took him in hand, had never known an honest individual. While this is an extreme case, such as may be found only in the hearts of great cities, there are many children who have had much more experience with criminals than with the law-abiding. In such cases what the social psychologist calls "abnormal suggestion" operates to produce the juvenile delinquent. Some criminologists have collected considerable material showing the operation of such abnornal suggestion upon the plastic mind of the child, coming as it does, not alone from his ordinary home and community life, but also from the daily prints, the

cheap, sensational and melodramatic "novel," and the moving-picture theatre. In other cases moral obtuseness is due to feeble-mindedness, probably of a congenital origin. The psychopathologists of the juvenile courts and the psychopathic clinics have worked out elaborate tests for the detection and identification of such causes of juvenile delinquency, and have applied appropriate remedies with marked success. So far has this work gone that in the juvenile courts of the United States the child ordinarily is not treated as a criminal at all, but as a defective who needs to be readjusted, through some social or organic process, to the social word in which he should live. If he proves incapable of such adjustment, or if the facilities for adjusting him are insufficient, he is, of course, segregated from contaminating contacts with his kind.

Like psychopathic methods are coming to be applied to adult offenders in most modern countries where criminals are no longer thought of as radically different from the ordinary run of people. The difference between so-called normal and abnormal individuals is coming to be recognized as largely one of degree, the personal defect usually being more pronounced in the offender than in the average person. Investigations of the individual or organic causes of adult crime were begun by the psychiatrists several decades ago.

Maudsley made some early studies in this field, while Lombroso did a great initial work in connection with criminal anthropology, although much of his work is now being revised and brought into agreement with more recent investigations.

The same general methods of psychopathic investigation and treatment are being applied increasingly to other classes of defectives, such as the insane, the feeble-minded, and the epileptic. It is found that large percentages of these classes can be cured, and other large portions alleviated, by proper employment of mental as well as physiological hygiene. The central point in mental hygiene as a method of the treatment of nervous and mental defectives is to so organize the attention or the mental activities of the individual that there can be no undue brooding, depression, or mind-wandering, such as to cause loss of mental self-control.

Thus we may conclude from this brief survey of the field that the application of the data of Psychology to social problems is twofold. An analysis of man's relations with the institutional and social world of which he is a part has disclosed the fact that he is not a purely intellectual animal with certain well-defined desires and sympathies which he endeavours to satisfy by the most cogent and effective reasoning. He is born

into a social system, with its institutions, its customs and traditions, its conventions, fashions, fads and crazes, which take hold of him and mould him to their measure through processes of conscious or unconscious suggestion. At times he revolts, and modifies or creates the system anew, but never to the extent that it creates him. On the other hand, there is a multitude of concrete, psychic, and organic adjustments going on in the realms of industry, of education, and in the rehabilitation of the abnormal and the subnormal. These aim at keeping the world in working order, and at making life as efficient and effective as possible. Such social control is largely a matter of the psychic adjustment of the individual to the concrete demands which life makes upon him. But as valuable as is the psychic adjustment of the abnormal and the subnormal to their social environment, the chief contribution of Psychology to the solution of social problems is doubtless to be found in the aid it gives to making normal processes more efficient.

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CHIEF PSYCHOLOGICAL TERMS

(See p. 46 *et seq.*)

Afferent nerves. The nerves that carry currents to the central nervous system—*i.e.*, brain and spinal cord.
After-image. Sensation remaining after removal of the cause.
Amœba. One of the lowest forms of known animal life.
Apperception. The entry of a presentation into the full focus of attention.
Assimilation. The adjustment of new mental experiences to existing knowledge.
Attention. Activity of the subject by which it heightens the realization of impressions.
Auto-suggestion. Suggestion self-applied.

Cerebration. Classification and interpretation of sensations.
Cognition. Knowing, realization of sensations.
Conation. Striving.
Conatus. Latin, endeavour.
Consciousness. State of wareness of sensations.
Continuity of consciousness. The grouping together of various impressions by a "knowing" subject.

Efferent nerves. Carry currents to the muscles and glands.
Ego. Self, the "I know that I am I."

Focus of attention. The portion of the psychosis in which we find the most intense degree of consciousness.

Habits. The tendency for a nerve-current to lead to a definite action.
Hypnotism. Theory and practice of inducing a condition of trance or artificial sleep.

Inhibition. The control of nervous reaction.
Introspection. Analysis of one's own mind as it works.

Mind. See p. 47 *et seq.*

Neurone. A nerve-cell with appendages. Particles of which the brain and spinal cord are composed.

Psychology. Science of description and explanation of states of consciousness.

Psychoses. Total state of consciousness as existing at any given moment distinguished from the accompanying brain changes.

Psycho-therapeutics. Medical application of psychological methods.

Relativity, law of. The way in which we feel things in their relation to each other. The mind works by comparison. We know black and white, for instance, as opposite rather than as separate unconnected experiences.

Retentiveness. The power of absorbing and retaining knowledge.

Retrospection. The analysis of memory.

Sensation. Conscious state resulting from stimulation of sense-organ.

Sensations, organic. Those that arise from the body itself, as aches and pains.

Stimulus. The external phenomenon giving rise to a sensation.

Sub-consciousness or sub-attentive mind. That part of consciousness that is outside the theatre of immediate attention—the consciousness that directs automatic nervous action, as digestion, walking, etc., and habits.

Suggestion. The imparting of an idea by a *cue*, or indirect prompting.

Will-action prompted by feeling. The putting forth of active energy to move our own organs, or change something about us.

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